

AD _____

CONTRACT NUMBER DAMD17-88-C-8141

TITLE: Blast Overpressure Studies with Animals and Man

PRINCIPAL INVESTIGATOR: Daniel L. Johnson, Ph.D.

CONTRACTING ORGANIZATION: EG&G Management Systems, Incorporated
Albuquerque, New Mexico 87119-9100

REPORT DATE: August 1997

TYPE OF REPORT: Addendum, Task Order 1

PREPARED FOR: Commander
U.S. Army Medical Research and Materiel Command
Fort Detrick, Maryland 21702-5012

DISTRIBUTION STATEMENT: Approved for public release;
distribution unlimited

The views, opinions and/or findings contained in this report are those of the author(s) and should not be construed as an official Department of the Army position, policy or decision unless so designated by other documentation.

DTIC QUALITY INSPECTED 4

19970908 033

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE August 1997	3. REPORT TYPE AND DATES COVERED Addendum (Task Order 1)	
4. TITLE AND SUBTITLE Blast Overpressure Studies with Animals and Man			5. FUNDING NUMBERS DAMD17-88-C-8141	
6. AUTHOR(S) Johnson, Daniel L., Ph.D.				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) EG&G Management Systems, Incorporated Albuquerque, New Mexico 87119-9100			8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army Medical Research and Materiel Command Fort Detrick, Maryland 21702-5012			10. SPONSORING / MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES Addendum to DTIC ADA280440				
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words)				
14. SUBJECT TERMS Blast, Overpressure, Sheep			15. NUMBER OF PAGES 66	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT Unlimited	

APPENDIX E. SUMMARY OF EACH SUBJECT'S
PATH THROUGH THE MATRIX

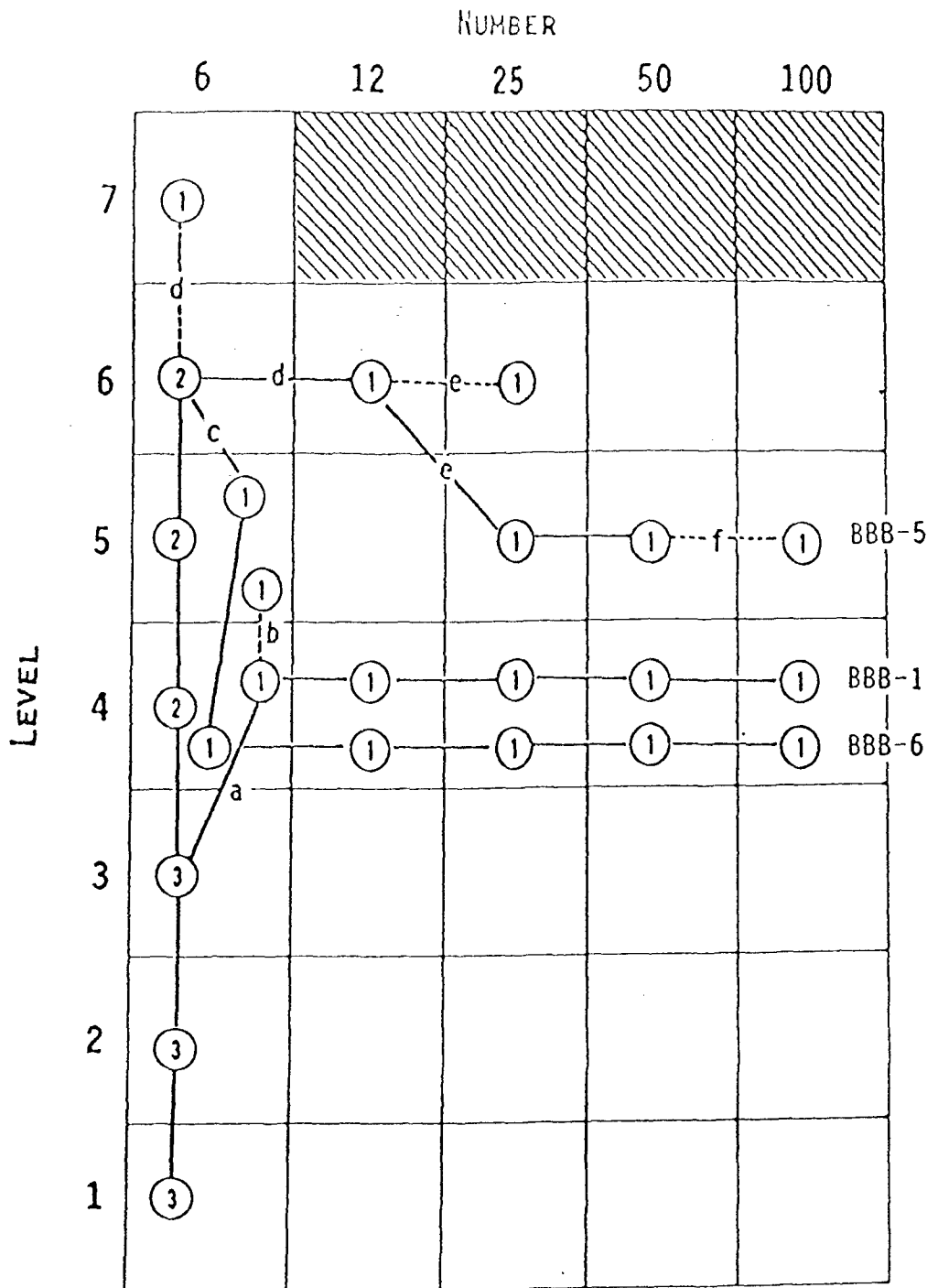


Figure E-1. Group BBB, September-October 1989, 5-M Distance, Unmodified Muff.

- a. BBB-1 delayed on 21 September one day because of upset stomach.
- b. BBB-1 elected not to go to Level 5.
- c. BBB-6 had nonauditory failure after Level 6 and then after Level 5.
- d. BBB-5 not allowed to go to Level 7 (PI discretion).
- e. BBB-5 elected to continue to Level 5.
- f. BBB-5 terminated after 50 exposures at Level 5 for disciplinary reasons.

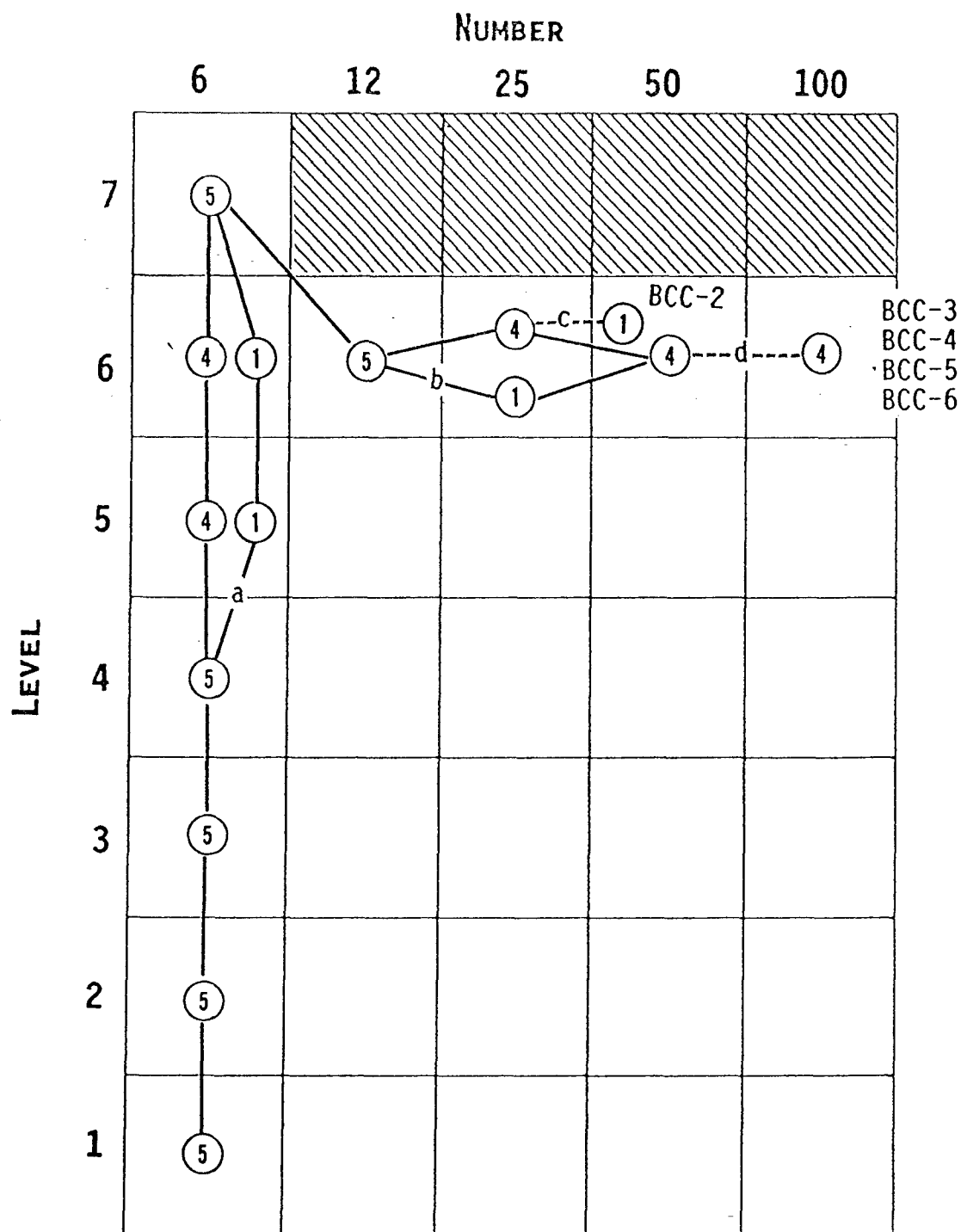


Figure E-2. Group BCC, November 1989, 5-M Distance, Unmodified Muff.

- a. BCC-2 delayed because of difficulty taking audiograms (variability too small).
- b. BCC-5 delayed because of headache and neck strain.
- c. BCC-2 elected not to go to 50 exposures.
- d. BCC-3, BCC-4, BCC-5, and BCC-6 elected not to go to 100 exposures.

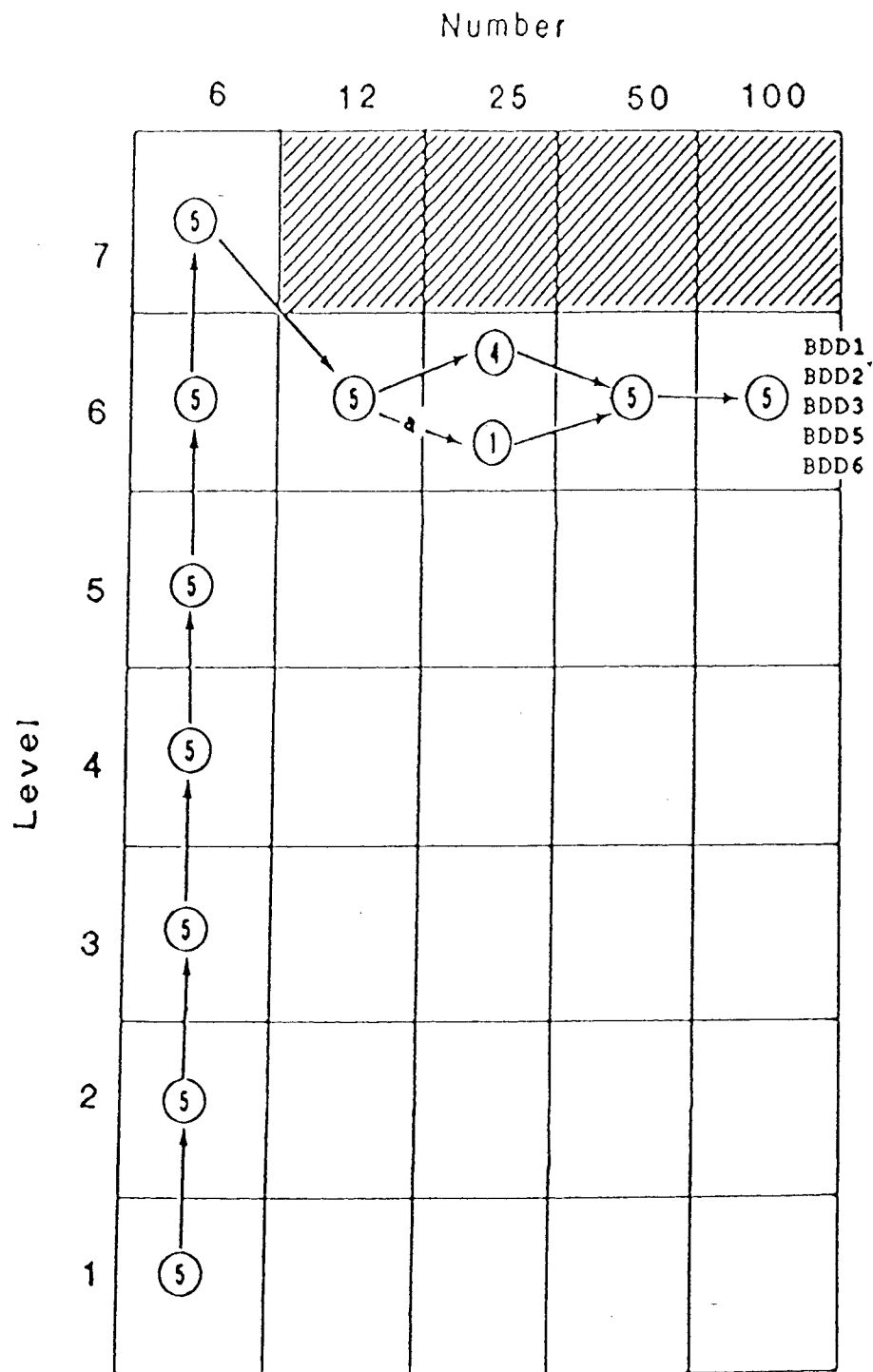


Figure E-3. Group BDD, January-February 1990. 5-M Distance, Unmodified Muff.
a. BDD-5 delayed one day because of stomach cramps. Caught up at Level 6/25.

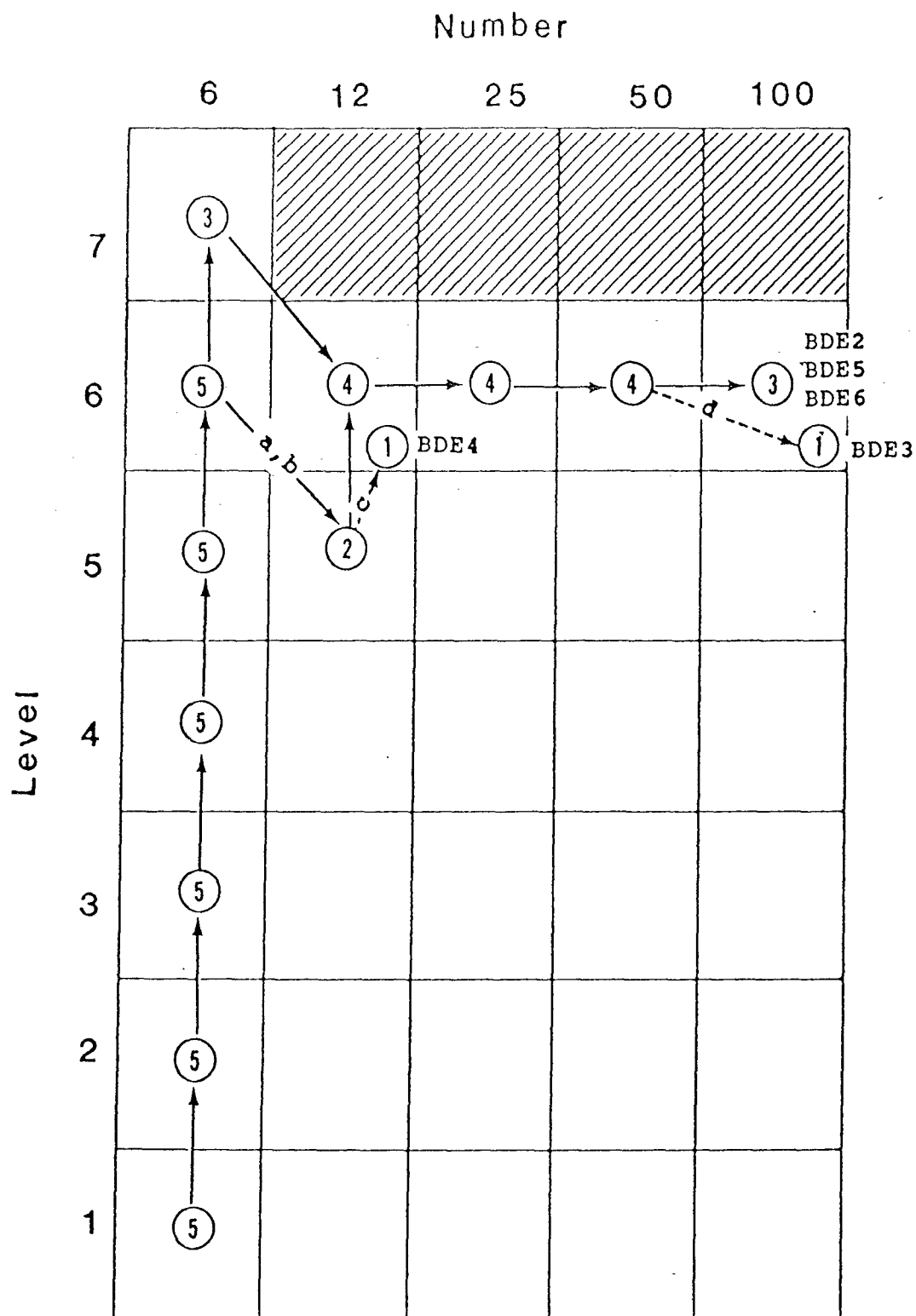


Figure E-4. Group BDE, January-February 1990, 5-M Distance, Unmodified Muff.

- a. BDE-5 conditional TTS.
- b. BDE-4 elective failure; agreed to go to Level 12/5.
- c. BDE-4 stopped before Level 12/6 because of exercise asthma.
- d. BDE-3 elective failure; did not want exposure at 100 at any level.

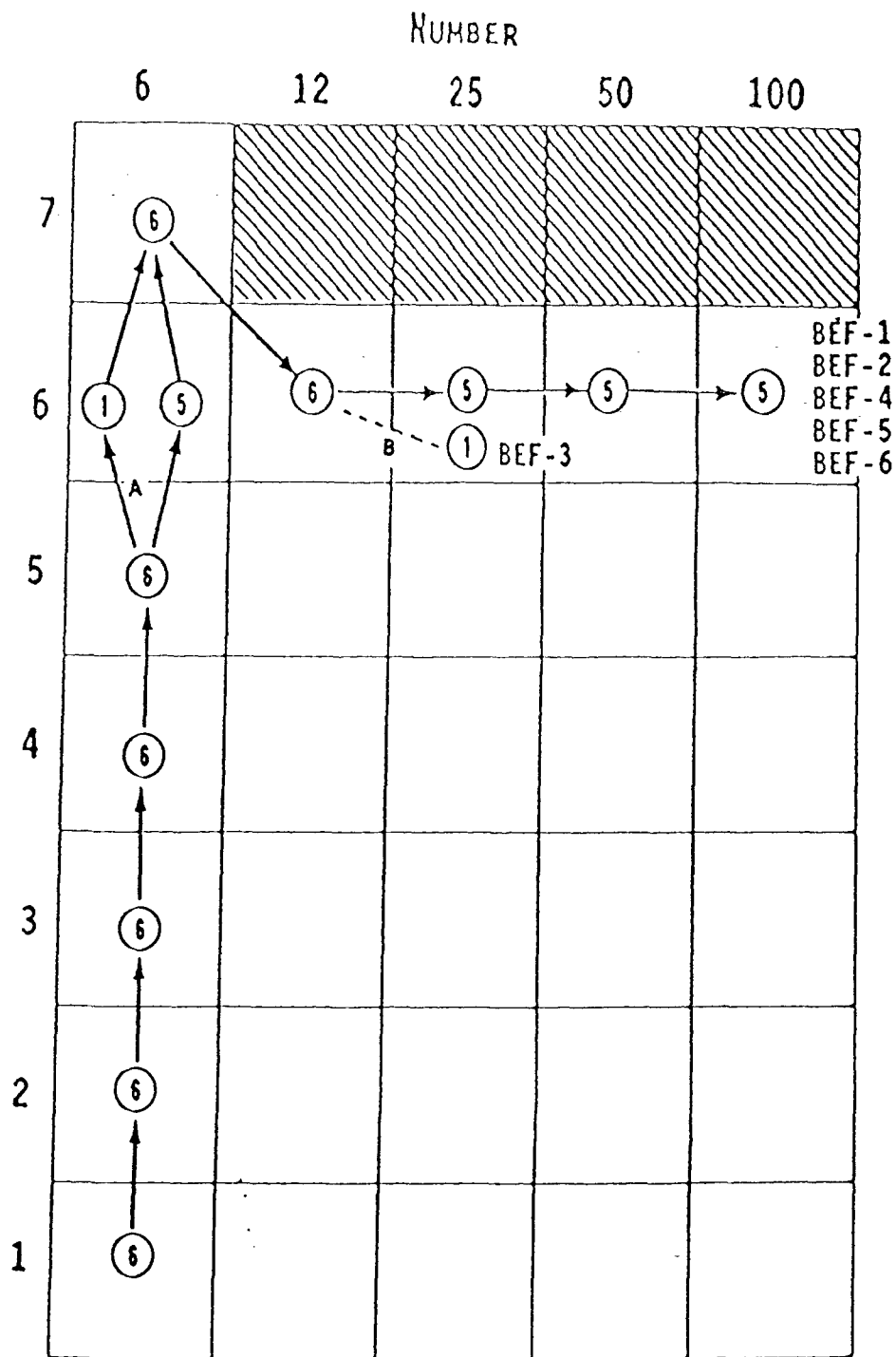


Figure E-5. Group BEF, March-April 1990, 5-M Distance, Unmodified Muff.

a. BEF-3 delayed one day because of headache.

b. BEF-3 elected to stop after Level 6/12.

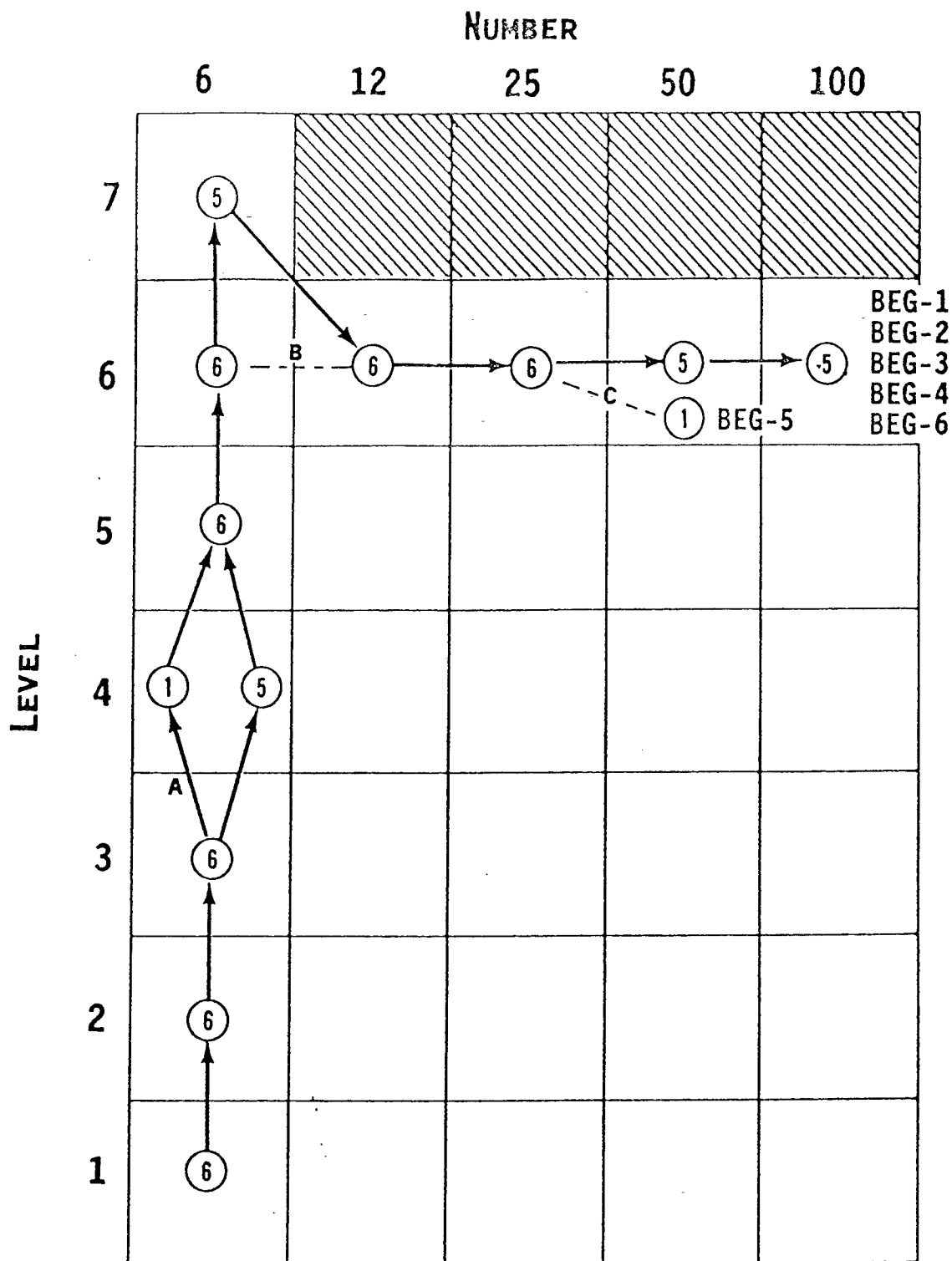


Figure E-6. Group BEG, 13 March-29 March 1990, 5-M Distance, Unmodified Muff.

- a. BEG-6 delayed due to ear inflammation.
- b. BEG-5 elected not to go to Level 7.
- c. BEG-5 elected to stop after 25. Did not want further exposure at any level.

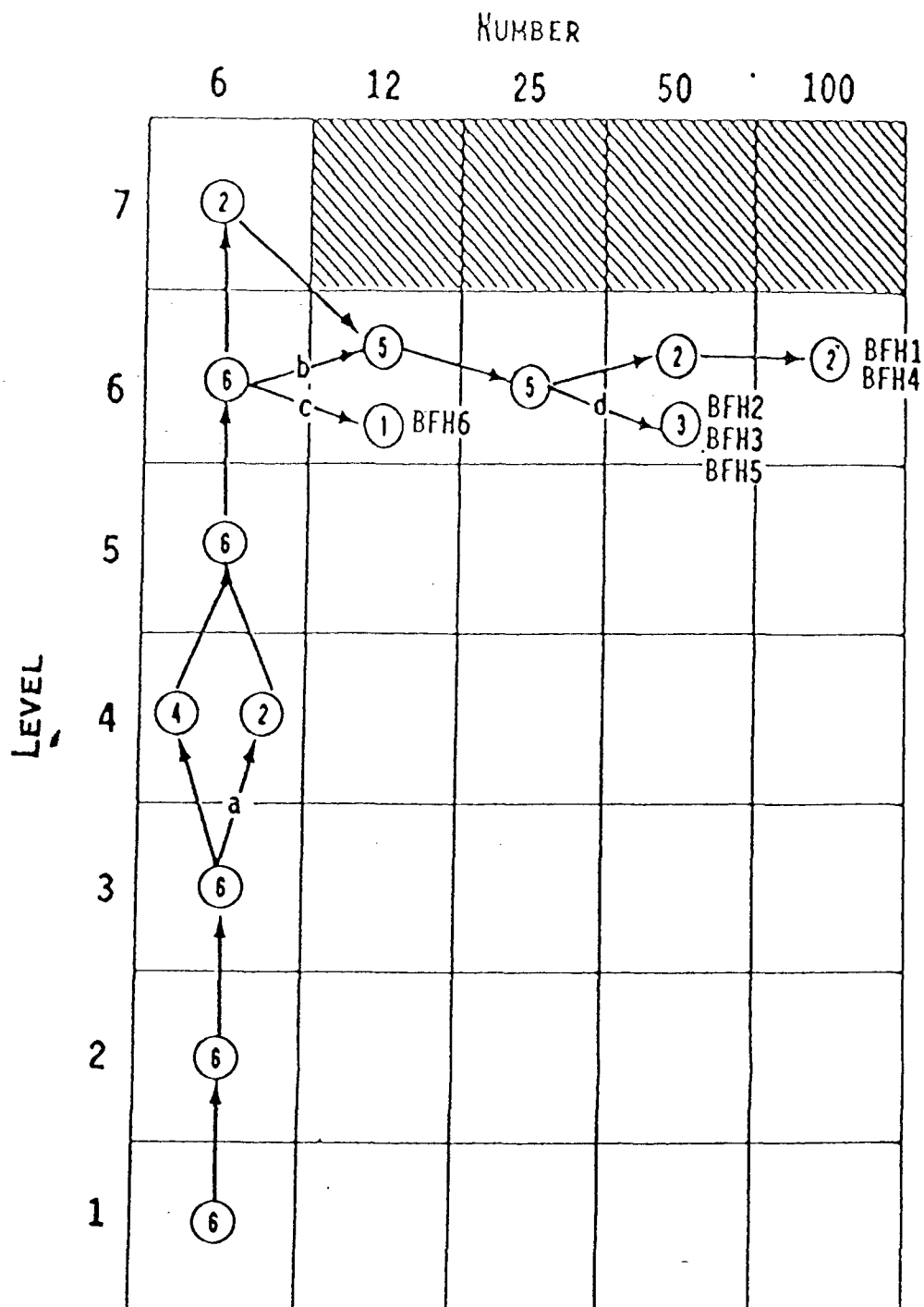


Figure E-7. Group BFH, April-May 1990, 5-M Distance, Unmodified Muff.

- a. BFH-2 and BFH-5 delayed due to flu.
- b. BFH-2, BFH-3, and BFH-5 elected not to go to Level 7.
- c. BFH-6 elected not to go to either Level 7 or Level 6/12.
- d. BFH-2, BFH-3, and BFH-5 elected to quit after Level 6/25.

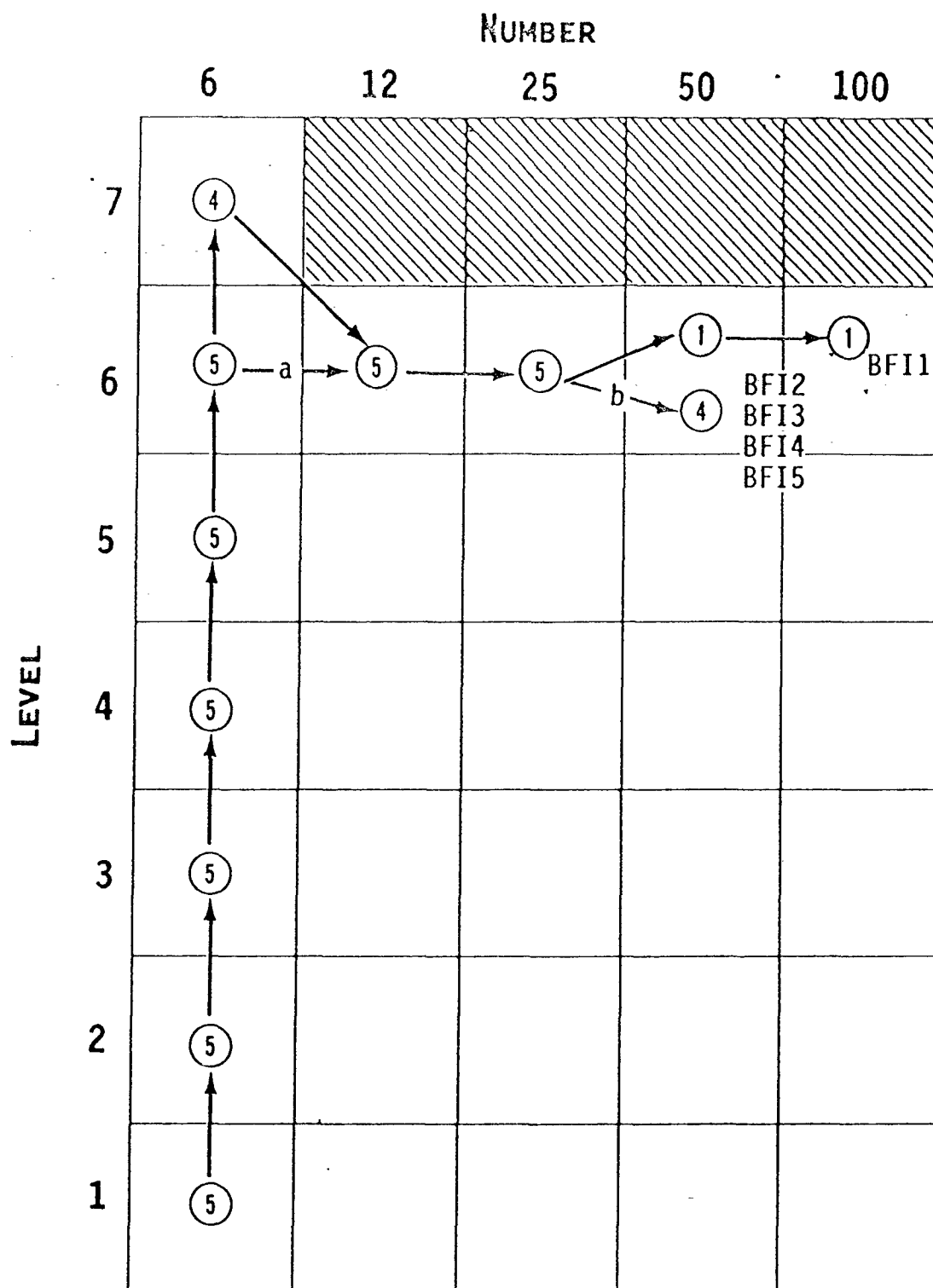


Figure E-8. Group BFI, April-May 1990, 5-M Distance, Unmodified Muff.
a. BFI-3 elected not to go to Level 7.
b. BFI-2, BFI-3, BFI-4, and BFI-5 elected not to go past 6/25.

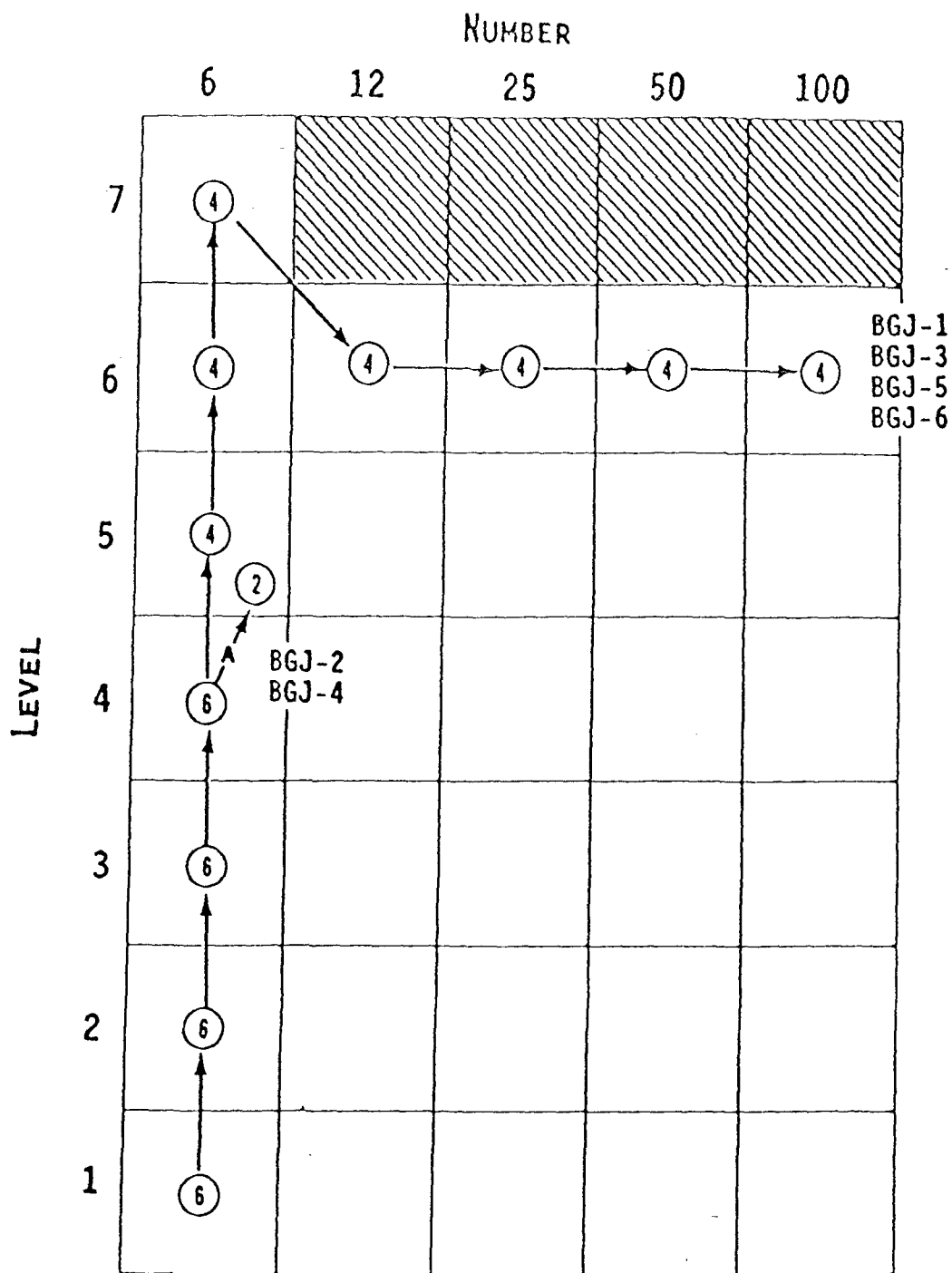


Figure E-9. Group BGJ, June-July 1990, 5-M Distance, Unmodified Muff.
 a. BGJ-1 and BGJ-4 administratively dropped from study after Level 4.

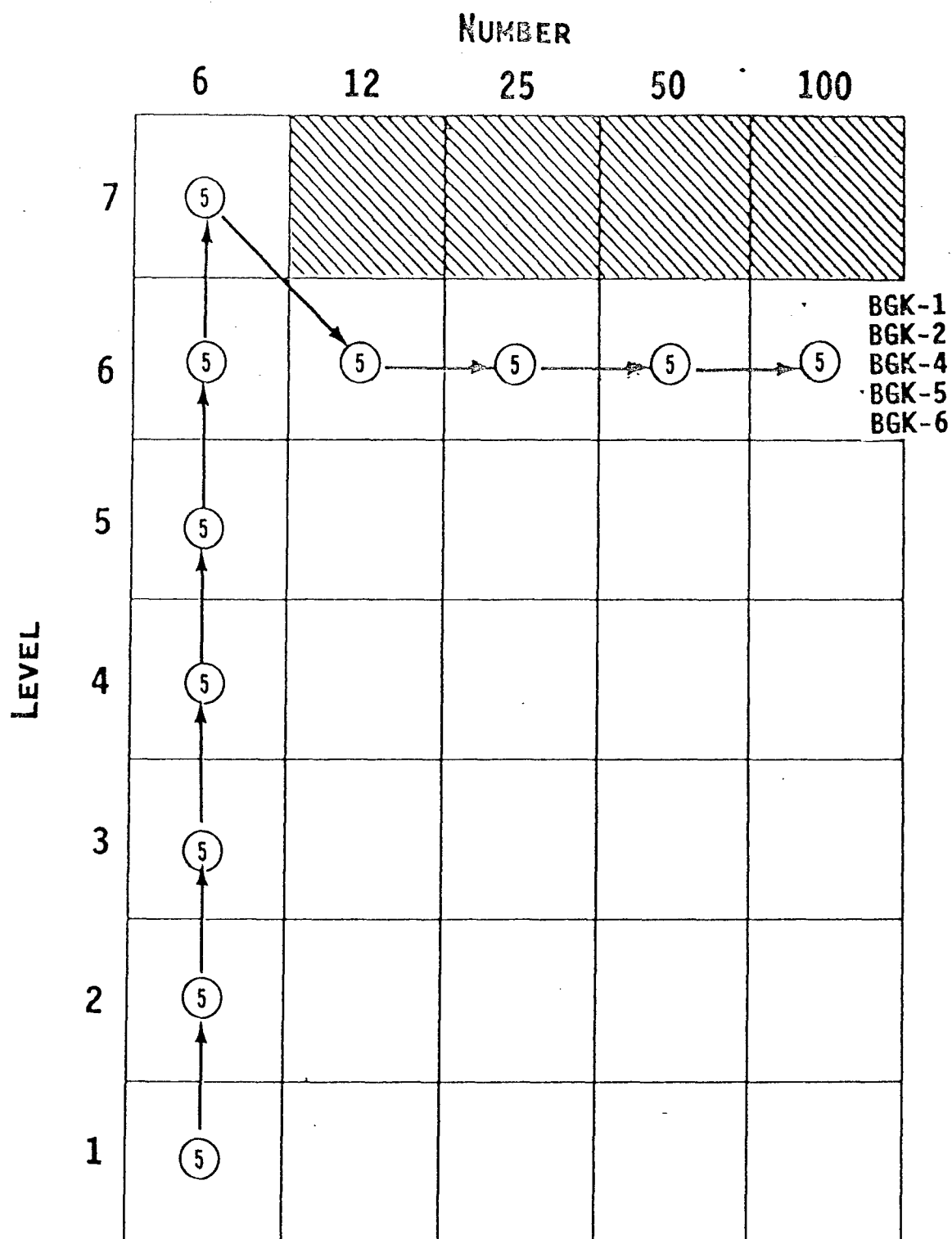


Figure E-10. Group BGK, June-July 1990, 5-M Distance, Unmodified Muff.

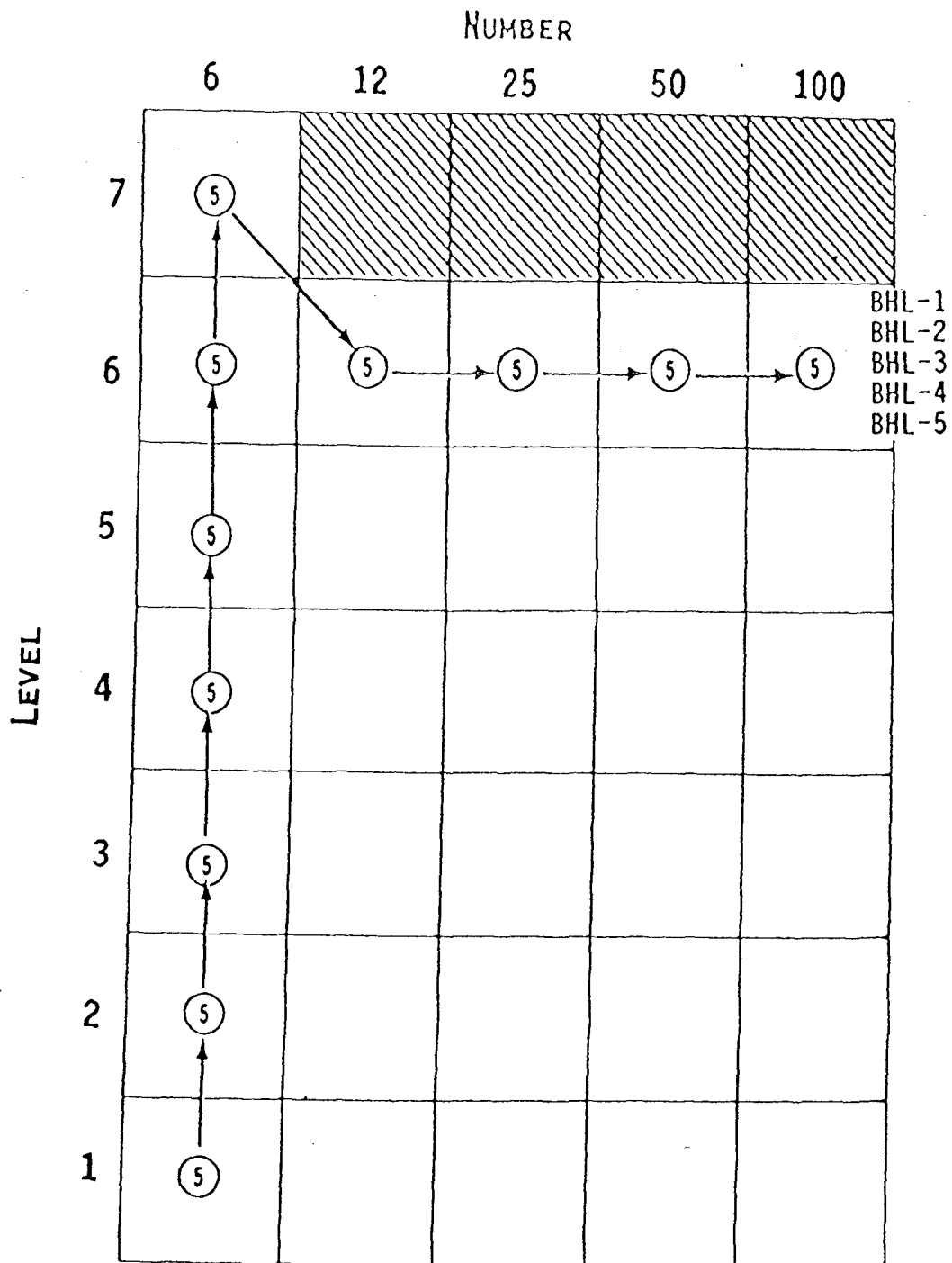


Figure E-11. Group BHL, August 1990, 5-M Distance, Unmodified Muff.

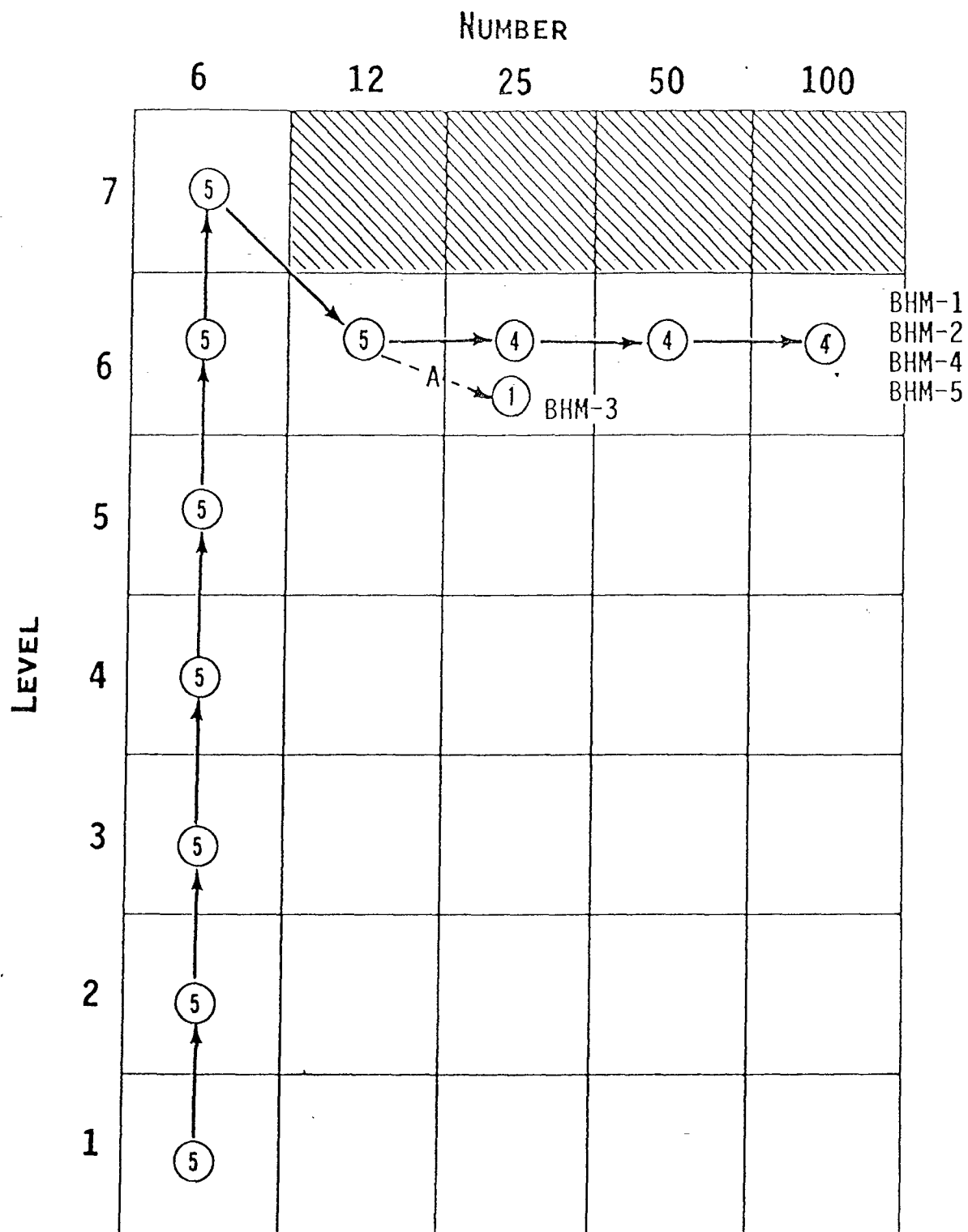


Figure E-12. Group BHM, August 1990, 5-M Distance, Unmodified Muff.
a. BHM-3 elected to stop after exposure at Level 6/12.

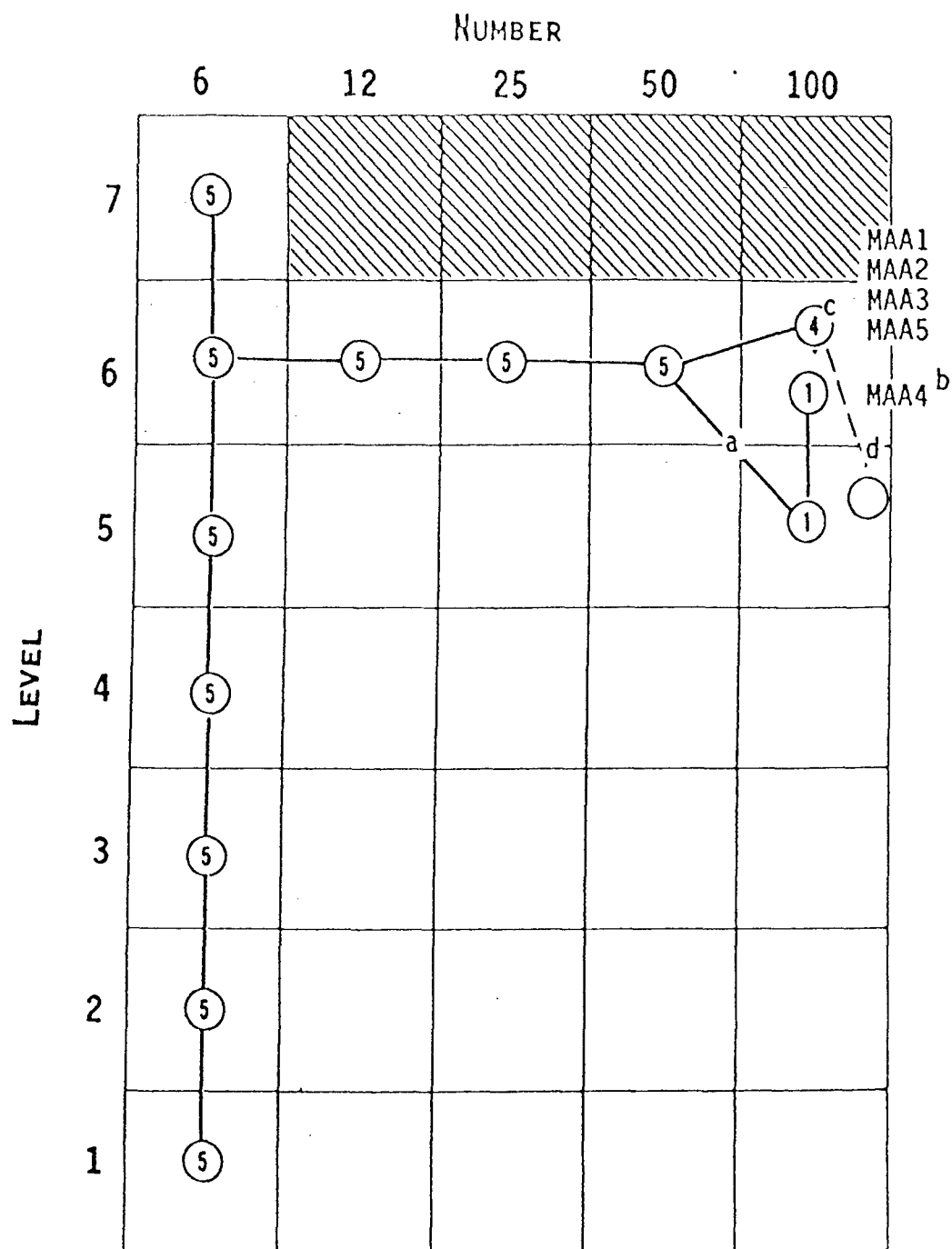


Figure E-13. Group MAA, September-October 1990, 5-M Distance, Unmodified Muff.

- a. MAA-4 conditional auditory failure at Level 6/50.
- b. MAA-4 was only exposed to 55 shots.
- c. MAA-2 had auditory failure after Level 6/100. MAA-5 had conditional auditory failure of 18 dB at 4 kHz. This grew to 27 dB at 20 min, then recovered.
- d. MAA-2 was not exposed to 5/100. This was PI's decision.

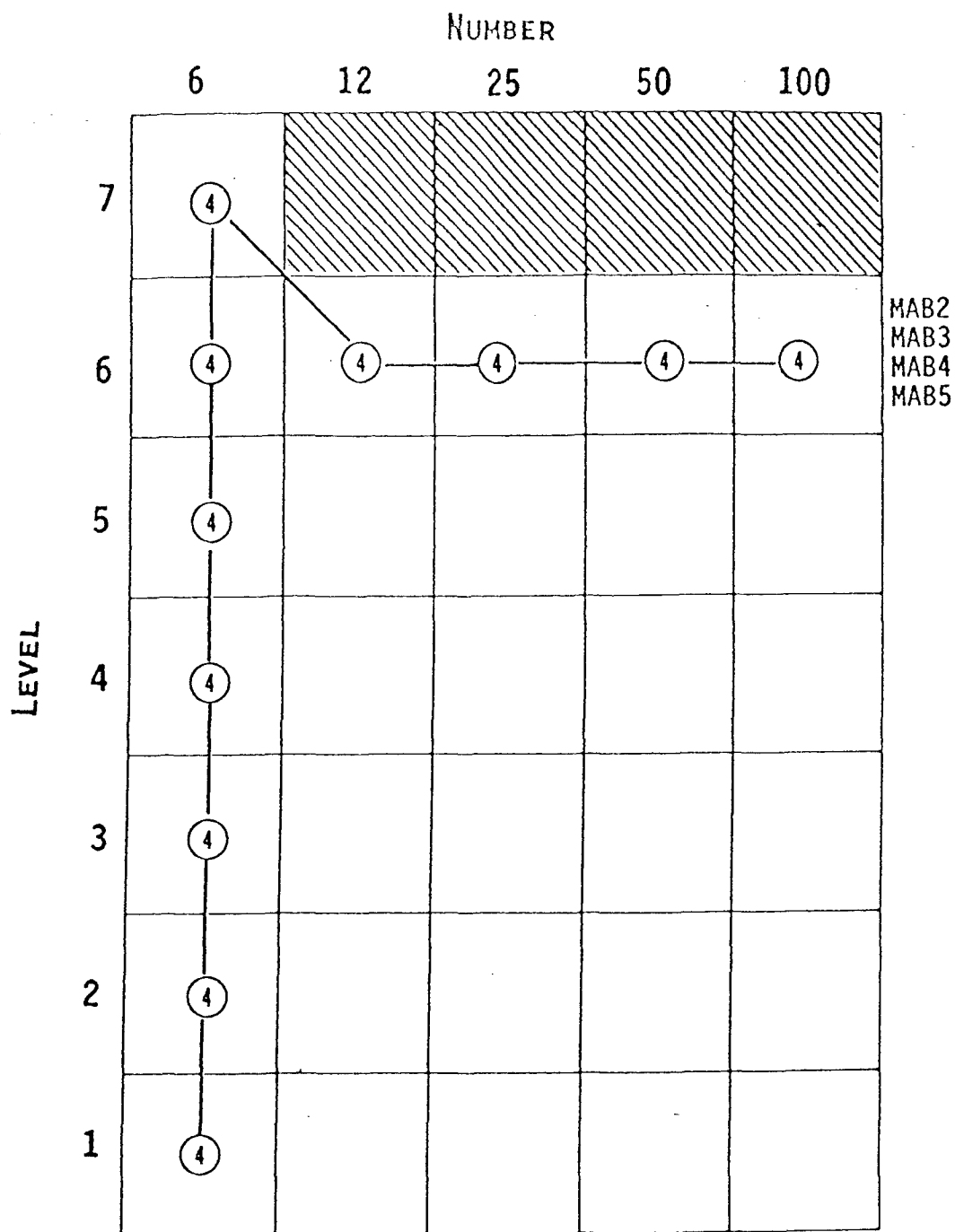


Figure E-14. Group MAB, September-October 1990, 5-M Distance, Modified Muff.

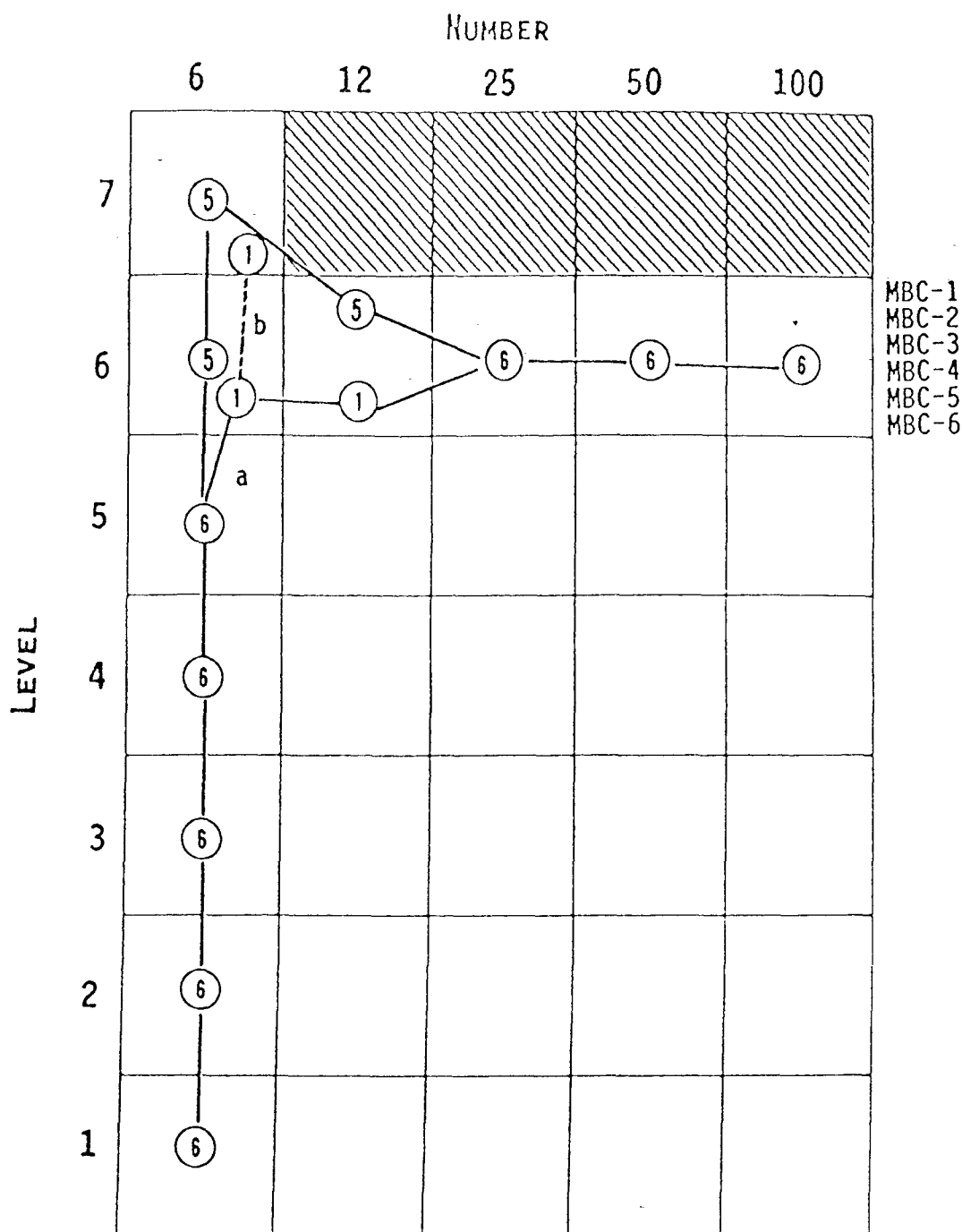


Figure E-15. Group MBC, November 1990, 5-M Distance, Modified Muff.

- a. Subject MBC-3 had inflamed tonsils and elevated thresholds. Not exposed for 2 days. Caught up with group for Level 6/25.
- b. Subject MBC-3 agreed to be exposed to 7/6 after 6/100 in order to catch up with group. After the 6/100 exposure, he elected not to be exposed to 7/6. Thus, he is an elective failure for 7/6.

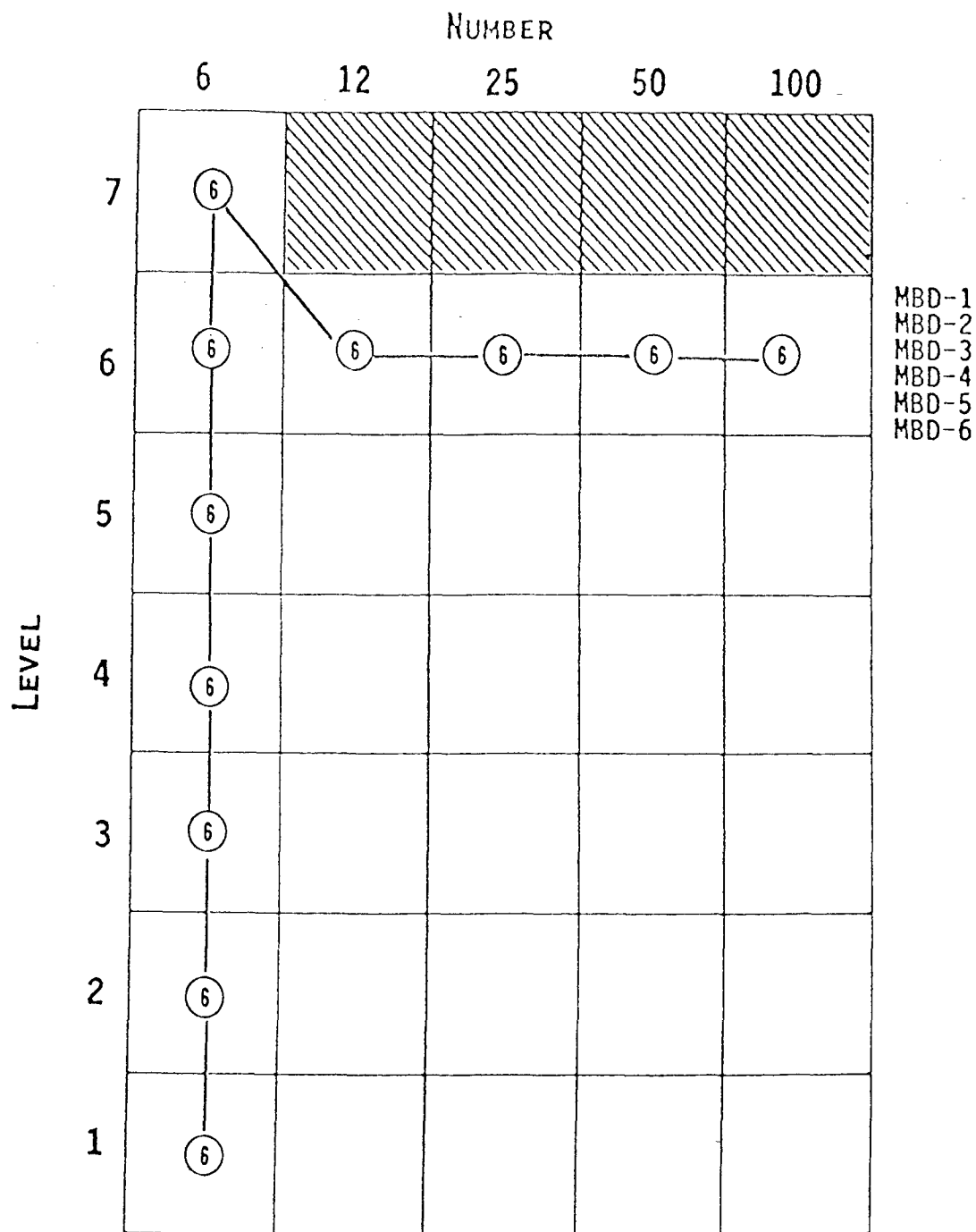


Figure E-16. Group MBD, November 1990, 5-M Distance, Modified Muff.

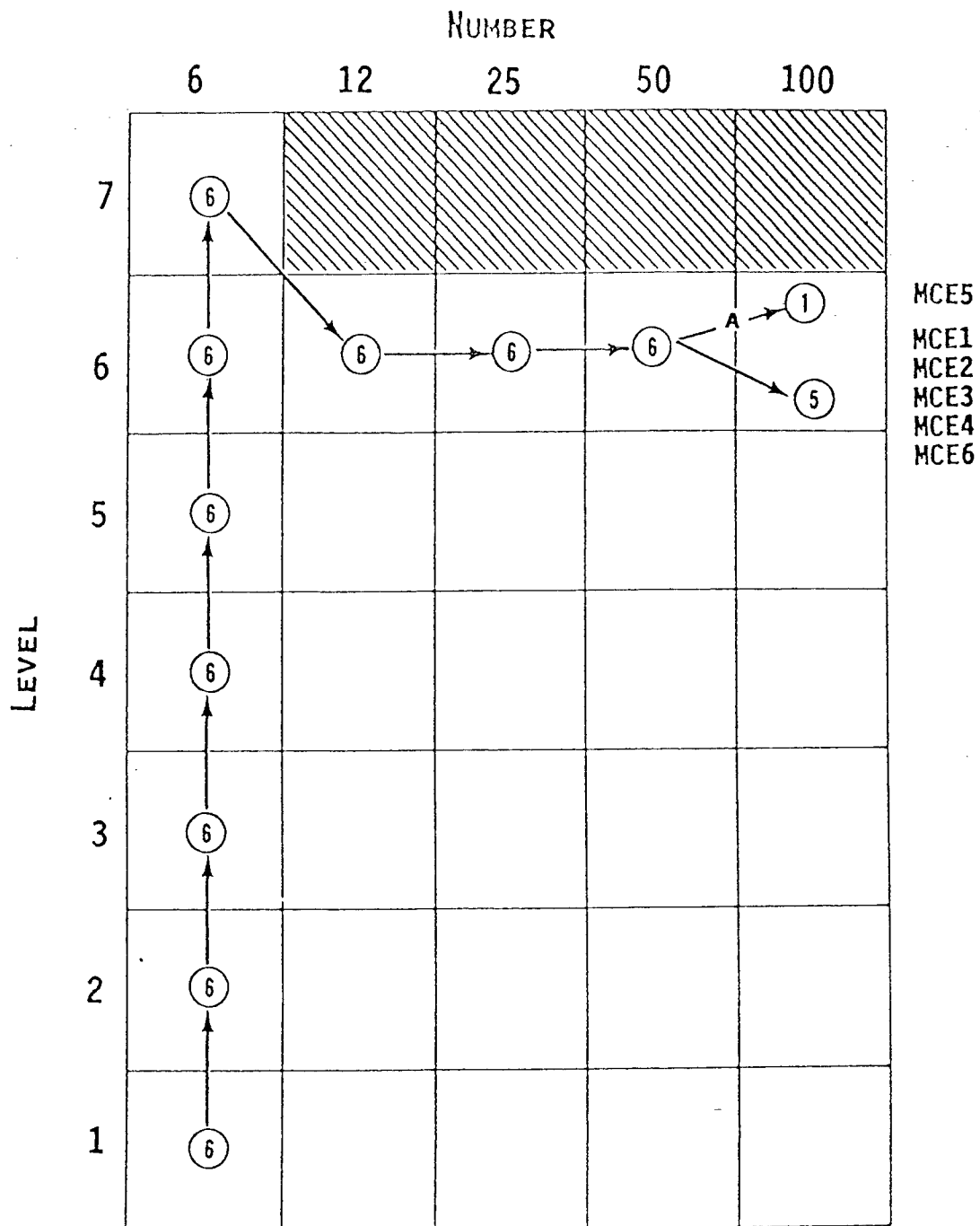


Figure E-17. Group MCE, January 1991, 5 M Distance, Modified Muff.
a. Subject MCE-5 was exposed to 6/100 on January 30 with Group MCF, replacing MCF-5.

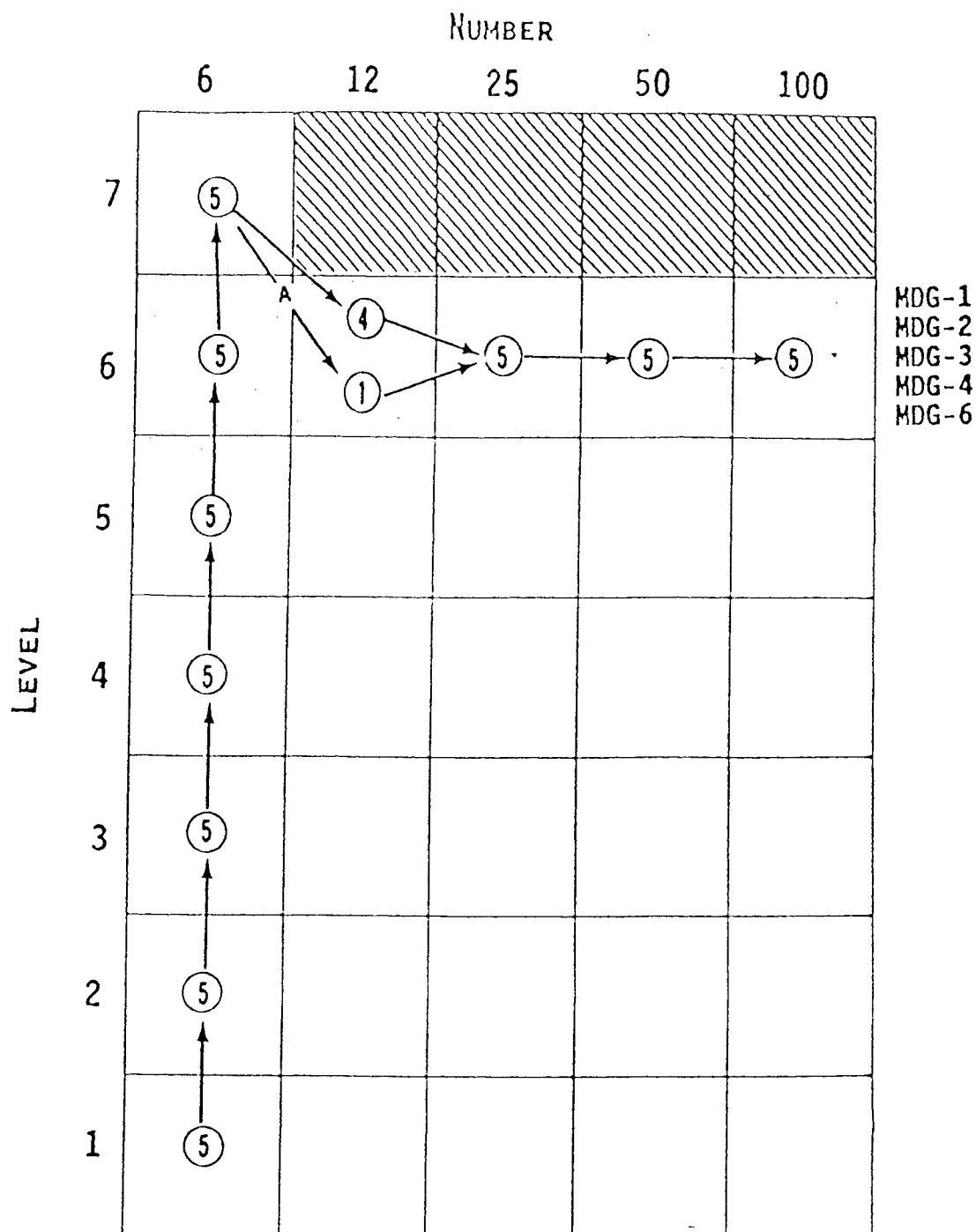


Figure E-19. Group MDG, February-March 1991, 5-M Distance, Modified Muff.

a. MDG-6 delayed for severe cold and was exposed by himself on 11 March 1991.

b. First exposure on 26 January and last exposure on 15 March 1991.

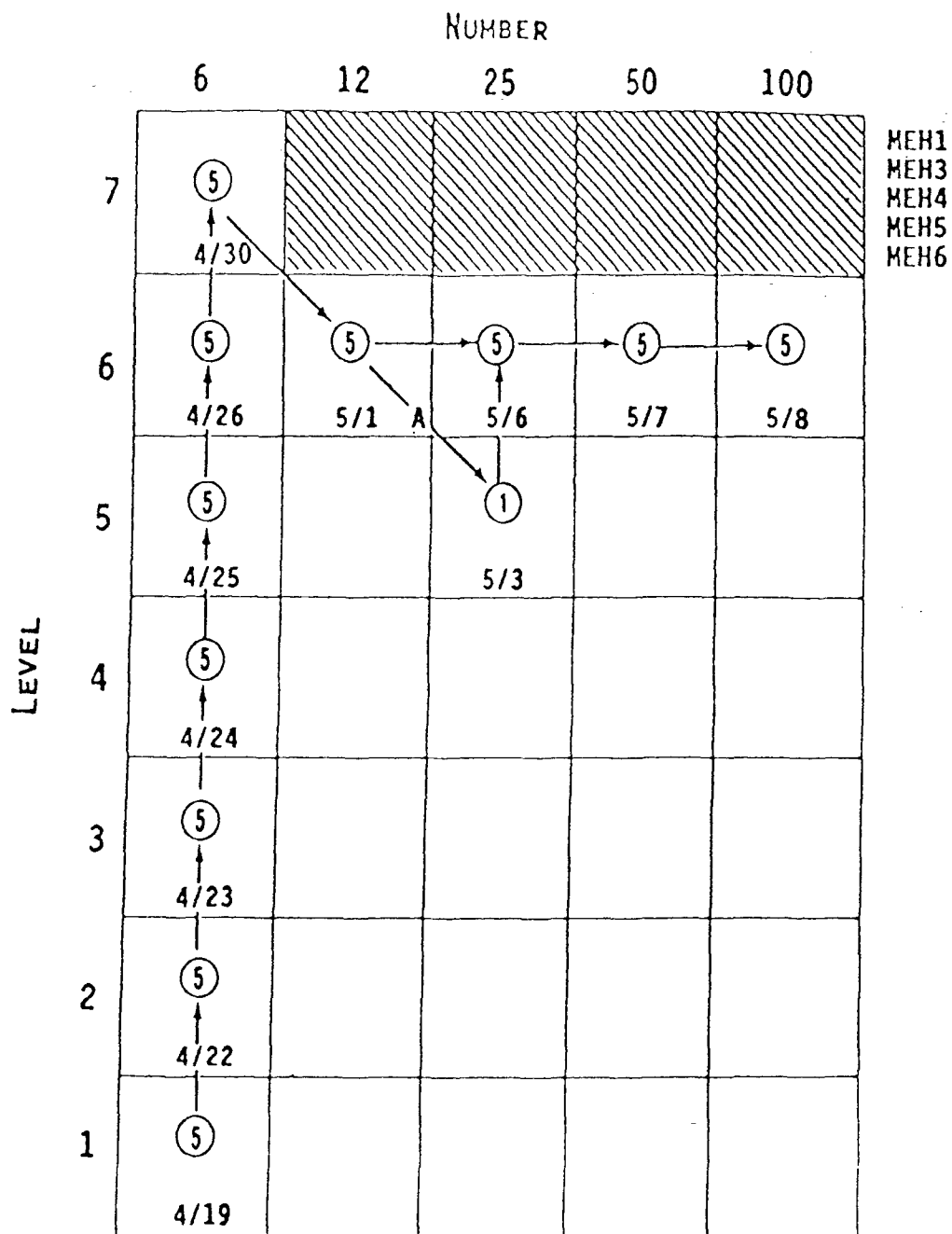
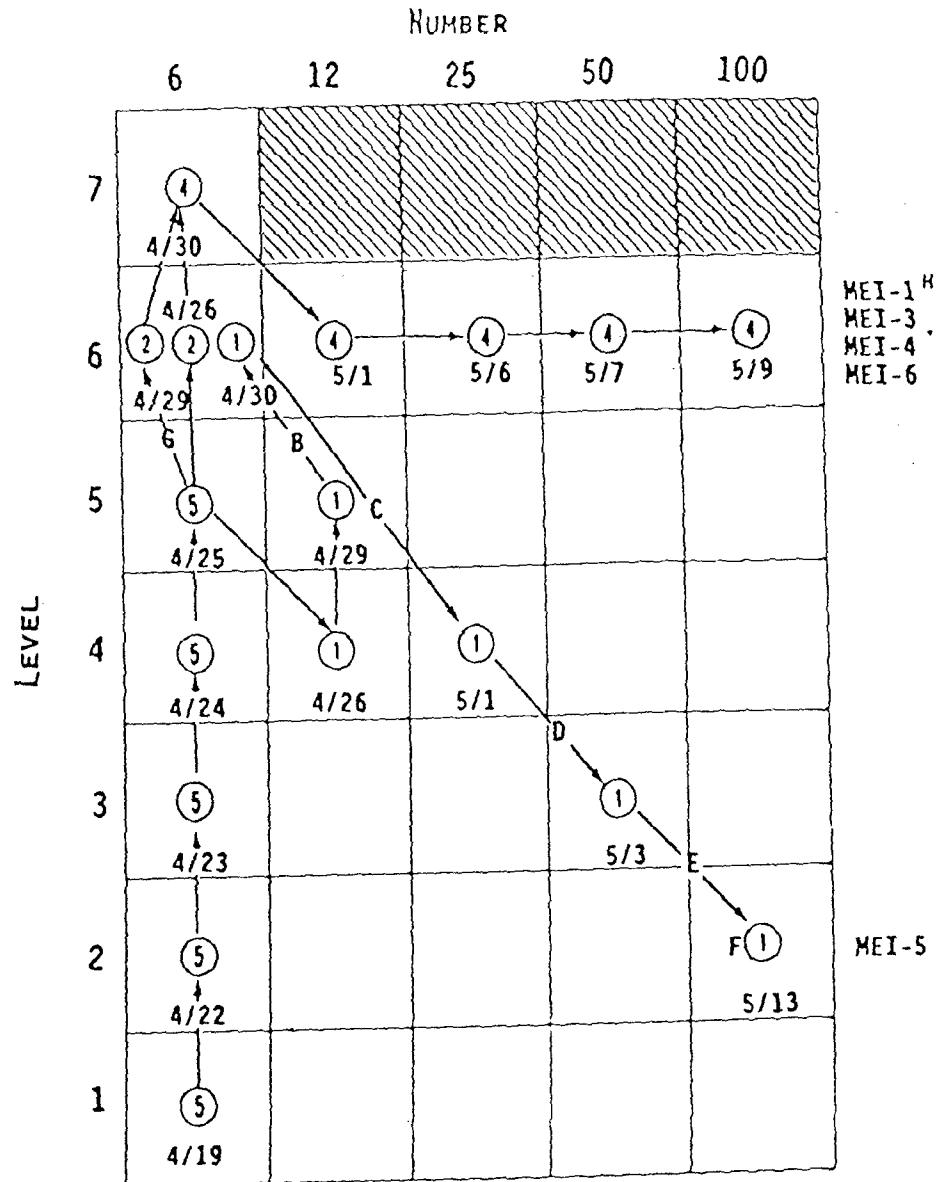


Figure E-20. Group MEH, April-May 1991, 5-M Distance, Modified Muff.
a. MEH-1 had conditional auditory failure at 6/12.



- Figure E-21. Group MEI, April-May 1991, 5-M Distance, Modified Muff.
- a. MEI-5 had conditional auditory failure at 5/6.
 - b. MEI-5 was exposed to 6/6 instead of 6/12 due to the PI's discretion.
 - c. MEI-5 had conditional auditory failure at 6/6.
 - d. MEI-5 had conditional auditory failure at 4/25.
 - e. MEI-5 had conditional auditory failure at 3/50.
 - f. MEI-5 had conditional auditory failure at 2/100. PI terminated exposure.
 - g. MEI-1 was delayed due to sickness.
MEI-2 was delayed due to middle ear pressure.
 - h. MEI-1 came off after 75 shots due to stomach cramps.

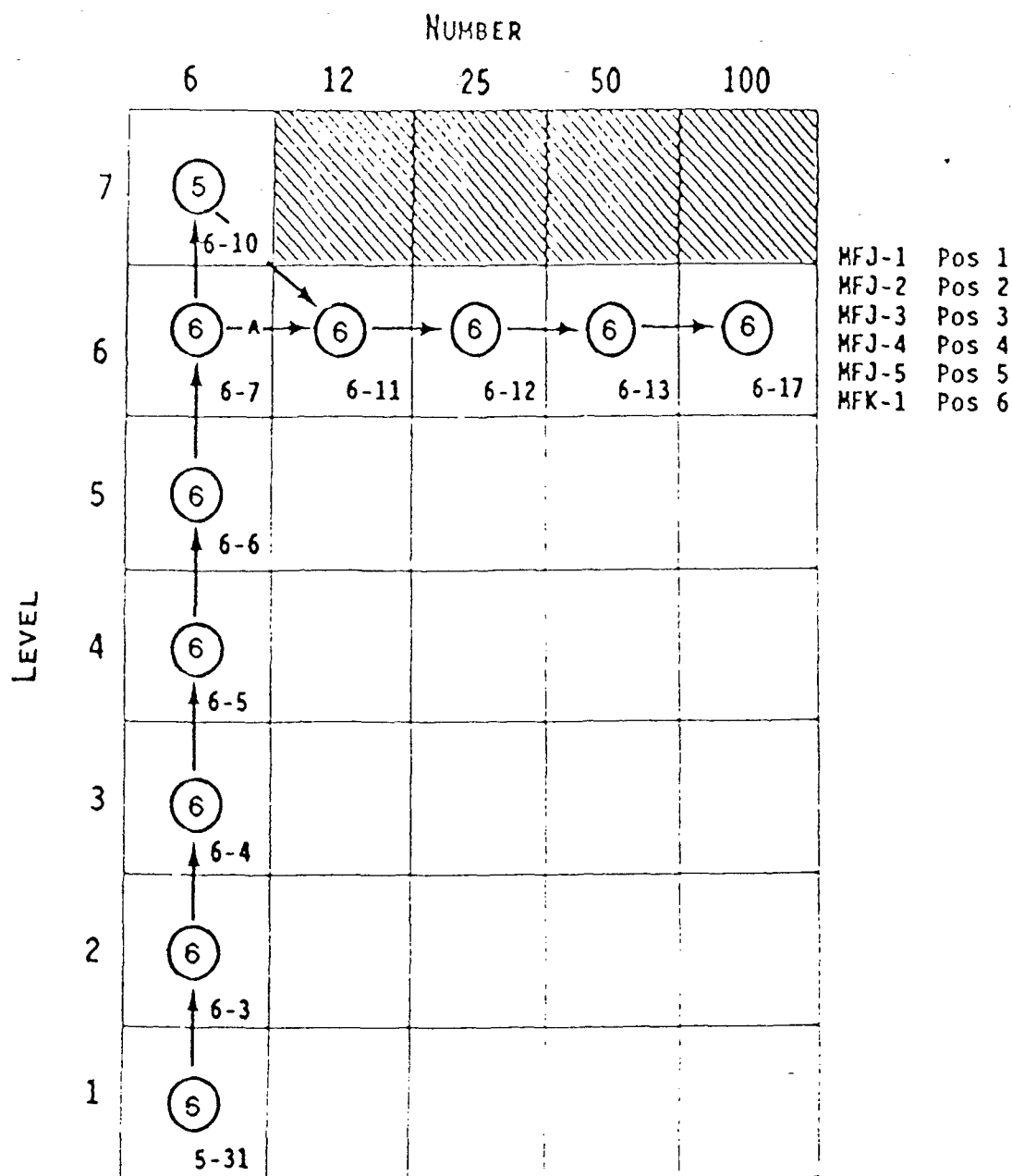


Figure E-22. Group MFJ, May-June 1991, 5-M Distance, Modified Muff.
a. MFJ-1 elected not to be exposed to level 7.

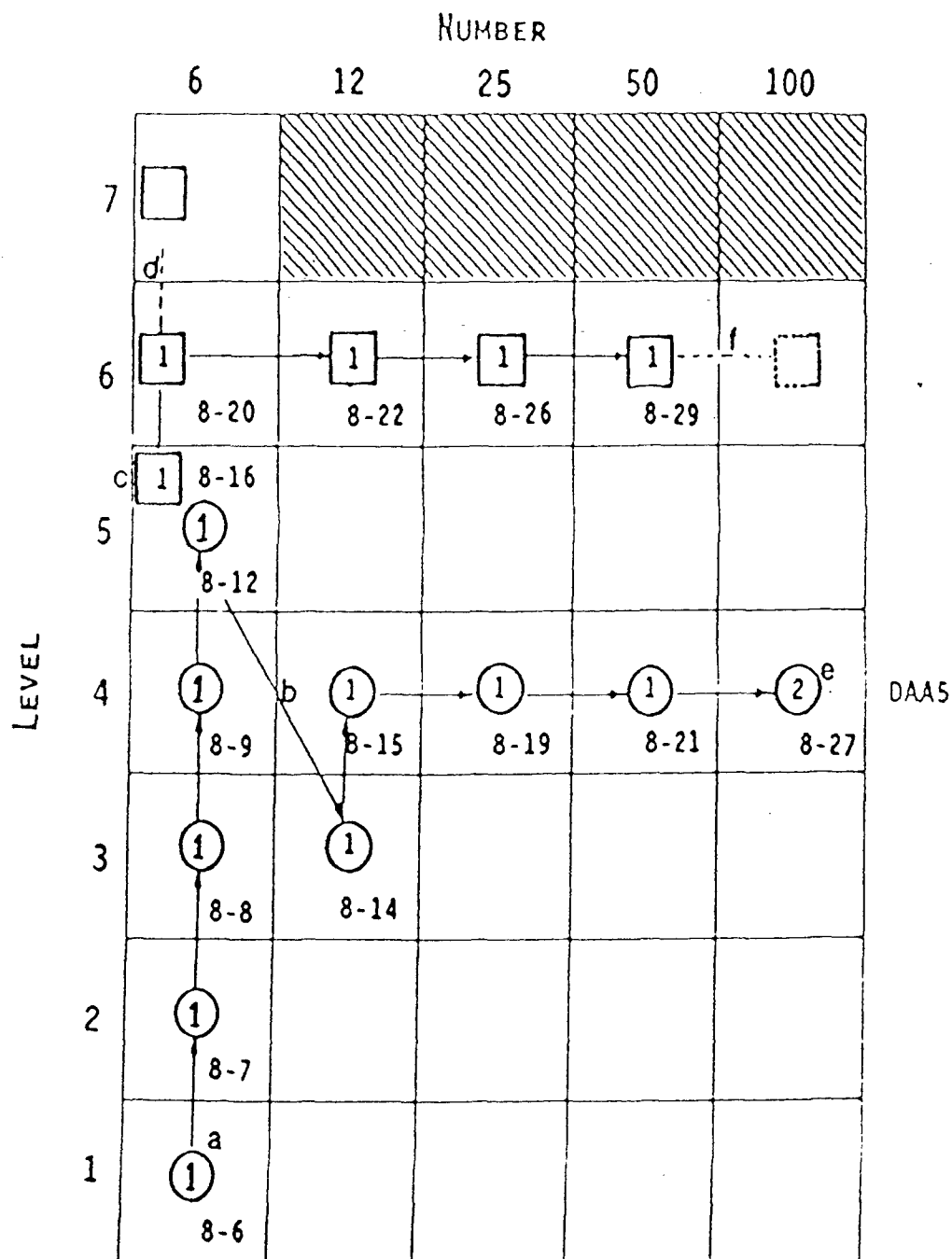


Figure E-24. Subject DAA5, August 1991, 1-M Distance, Modified Muff.

- a. Started with subjects DAB1 and DAB4.
- b. Audiometric failure after Level 5.
- c. Started second-level hearing protection at level 5.
- d. Elected not to go to level 7 with second-level hearing protection.
- e. Conditional failure after 4/100.
- f. Elected not to go to level 6/100 with second-level hearing protection.

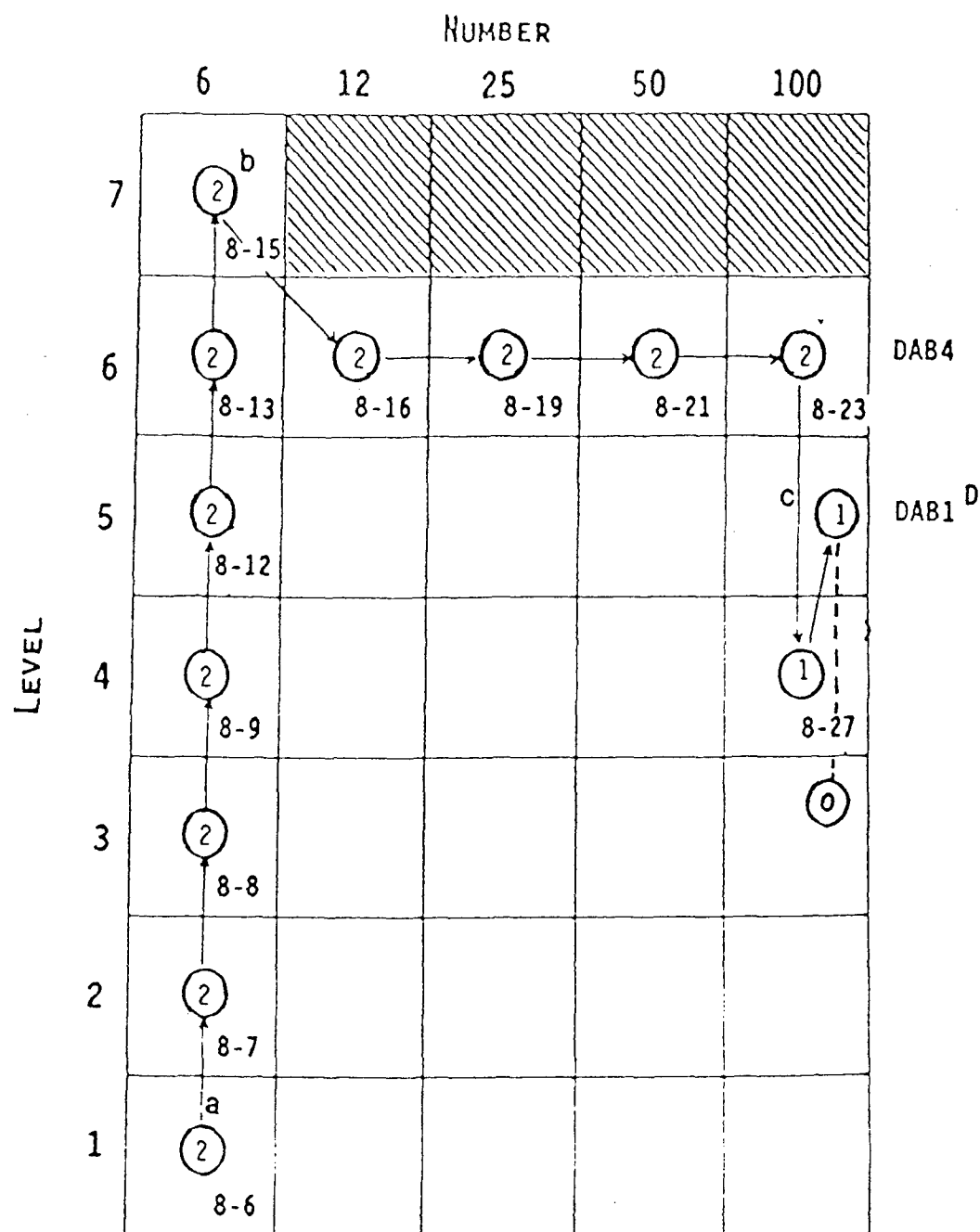


Figure E-25.

Group DAB, August 1991, 1-M Distance, Modified Muff.

- a. Subjects DAB-1 and DAB-4 started with subject DAA-5 in order to equalize the number of subjects exposed together.
- b. Group DAB combined with four subjects of group DAA.
- c. Subject DAB-1 had an auditory failure and a nonauditory failure after level 6/100.
- d. Subject DAB-1 had an auditory failure after level 5/100.

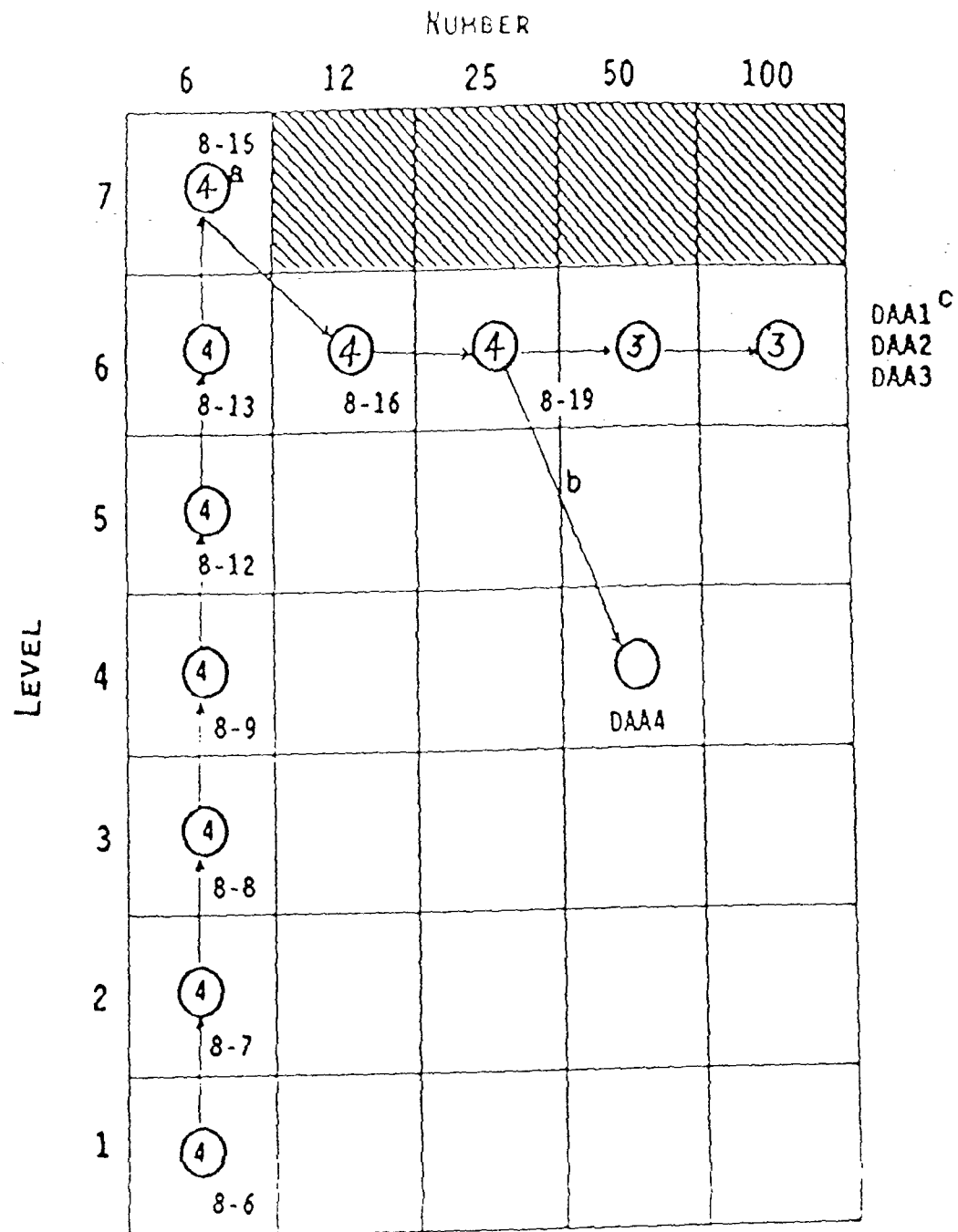


Figure E-26. Group DAA, August 1991, 1-M Distance, Modified Muff.

- a. Group DAA combined with two subjects of Group DAB.
- b. Subject DAA-4, an auditory failure after level 6/25, not allowed by the PI to continue because of delayed growth of the TTS.
- c. Subject DAA-1 was a conditional failure after level 6/100.

Figure E-27. Group DBC, September-October 1991, 1-M Distance, Modified Muff.

- a. Subject DBC-1 delayed due to cold that elevated hearing.
- b. Subject DBC-1 did not meet his baseline prior to 7/6. This exposure was delayed and the subject joined his group for 6/12.
- c. Subject DBC-4 was an auditory failure after 7/6.
- d. Subject DBC-4 was a conditional failure after 5/12.
- e. Subject DBC-4 was a conditional failure after 4/25.
- f. Subject DBC-4 was a conditional failure after 3/50.
- g. Subject DBC-6 was unable to meet his baseline on 10/4, 10/7, 10/8, and 10/9.
- h. Subject started second-level hearing protection at 6/12.
- i. Subject DBC-2 conditional failure after 6/50. Also, was a conditional failure at 5/100.
- j. Subject DBC-6 suffered a loosening of an impacted wisdom tooth after shot 14 of level 6/50. He came off the pad after shot 17. The medical monitor dropped him from further exposure.
- k. Subject DBC-4 was exposed to 2/100 and was a conditional failure.
- l. Subject DBC-4 was a conditional failure with second-level hearing protection after being exposed to 6/50 then after 5/100.
- m. Subject DBC-3 elected to stop further exposure and did not go to 6/12 on 17 October. He was sick until 17 October with a sore chest cage.

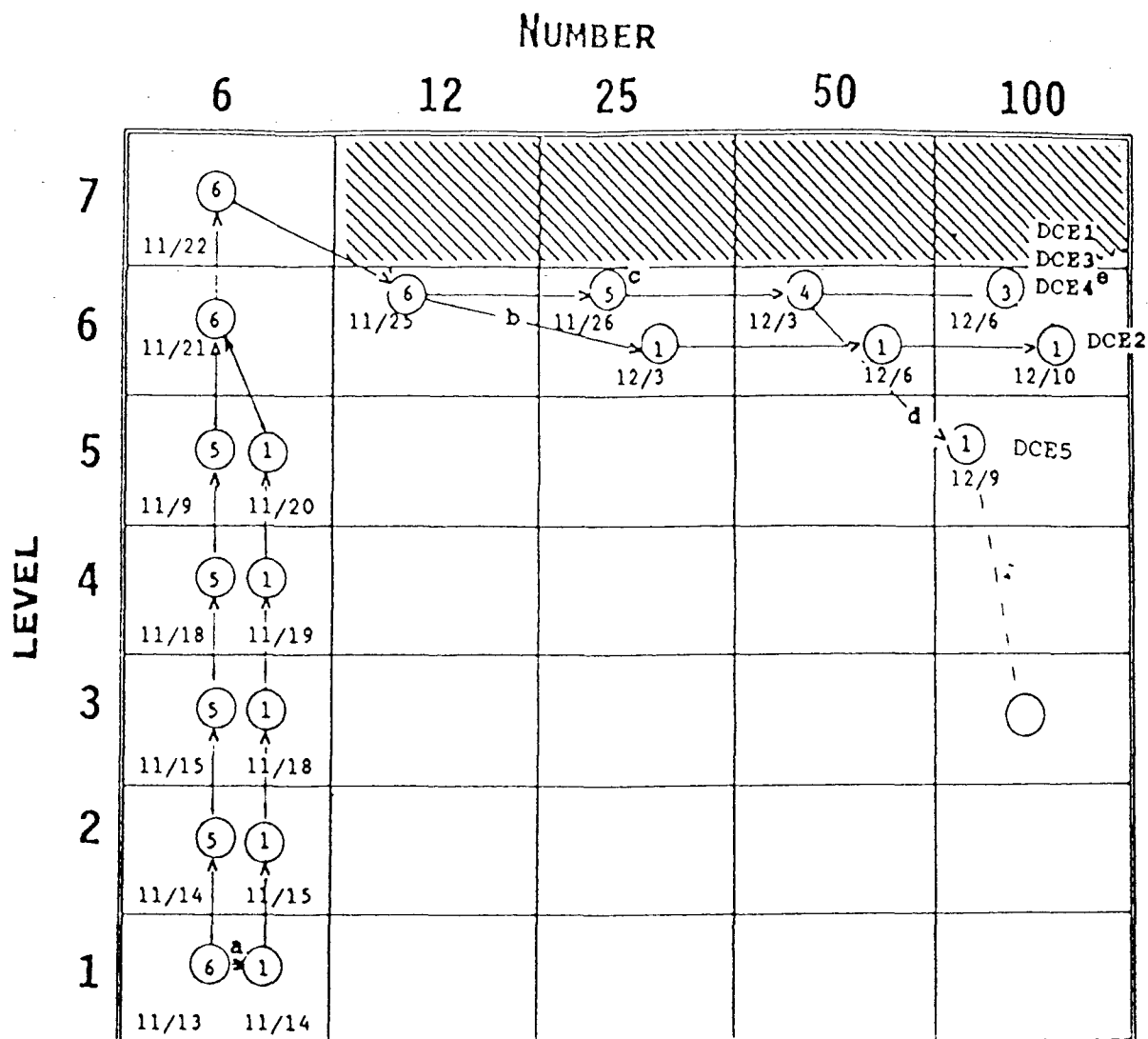


Figure E-29.

Group DCE, November-December 1991, 1-M Distance, Modified Muff.

- a. Subject DCE-5 conditional failure at level 1/6. Repeated that condition and passed.
- b. Subject DCE-2 delayed because of red spot in left ear.
- c. Subject DCE-6 dropped from further exposure due to a continuing sore throat and ear infection.
- d. Subject DCE-5 conditional failure at 250 Hz after level 6/50.
- e. Subject DCE-4 conditional failure after 6/100.
- f. Subject DCE-5 was a failure after 5/100. Because TTS was over 40 dB, PI elected not to expose again.

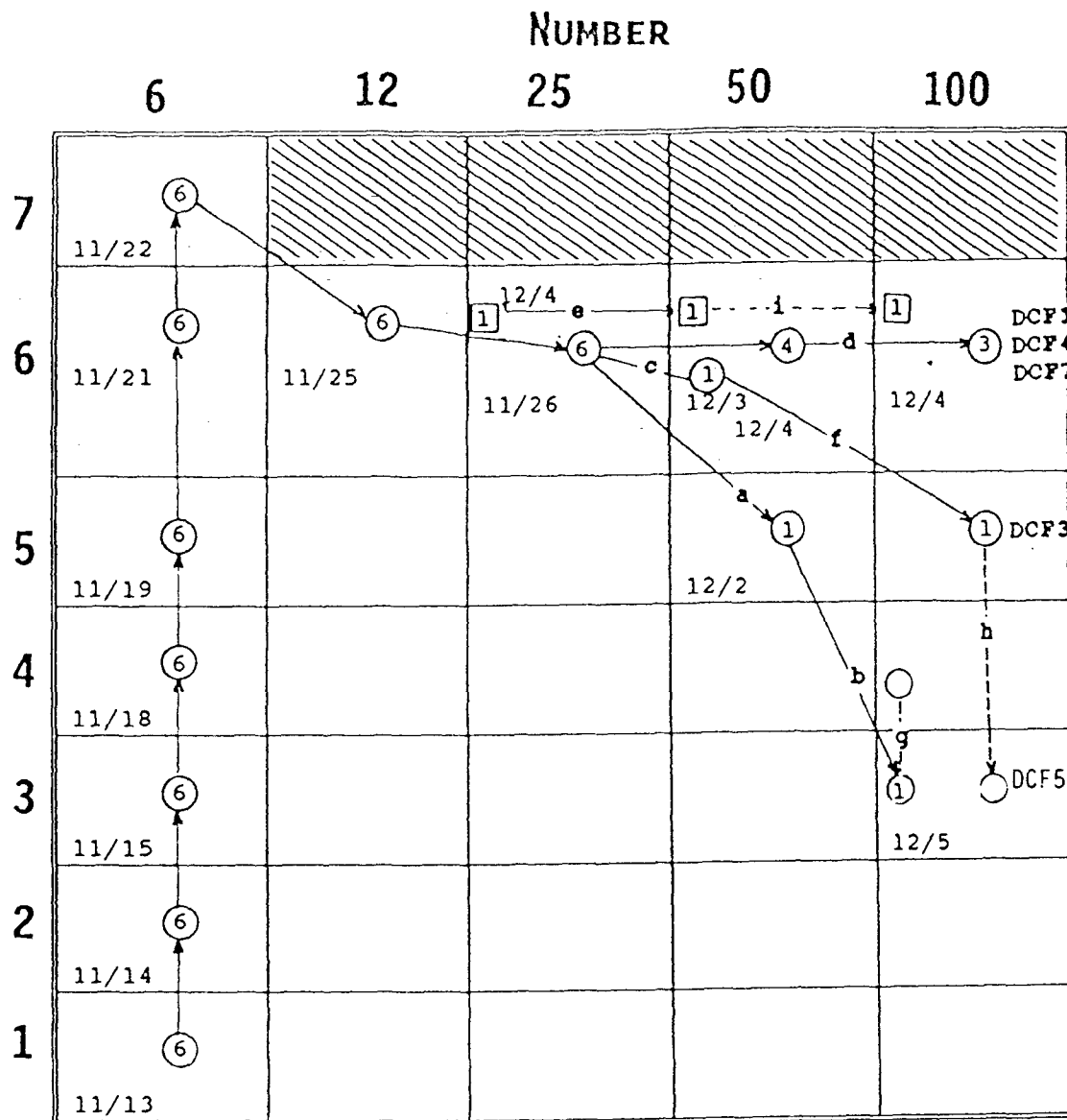


Figure E-30. Group DCF, November-December 1991, 1-M Distance, Modified Muff.

- Subject DCF-5 conditional failure at 8 kHz after 6/25.
- Subject DCF-5 failure at 8 kHz after 5/50.
- Subject DCF-3 delayed because subject felt he was too sick to be exposed.
- Subject DCF-2 was not exposed further because he was unable to stay within his baseline.
- Subject DCF-5 started second-level hearing protection.
- Subject DCF-3 was a conditional failure after 6/50. Brought off pad to shot 39 because of ear reddening.
- Subject DCF-5 barely passed 3/100; elected not to go to 4/100.
- Subject DCF-3 failure after 5/100. PI elected not to be exposed further because recovery required 48 hr and TTS was more than 50 dB.
- Subject DCF-5 elected not to go to 6/100 with second-level hearing protection.

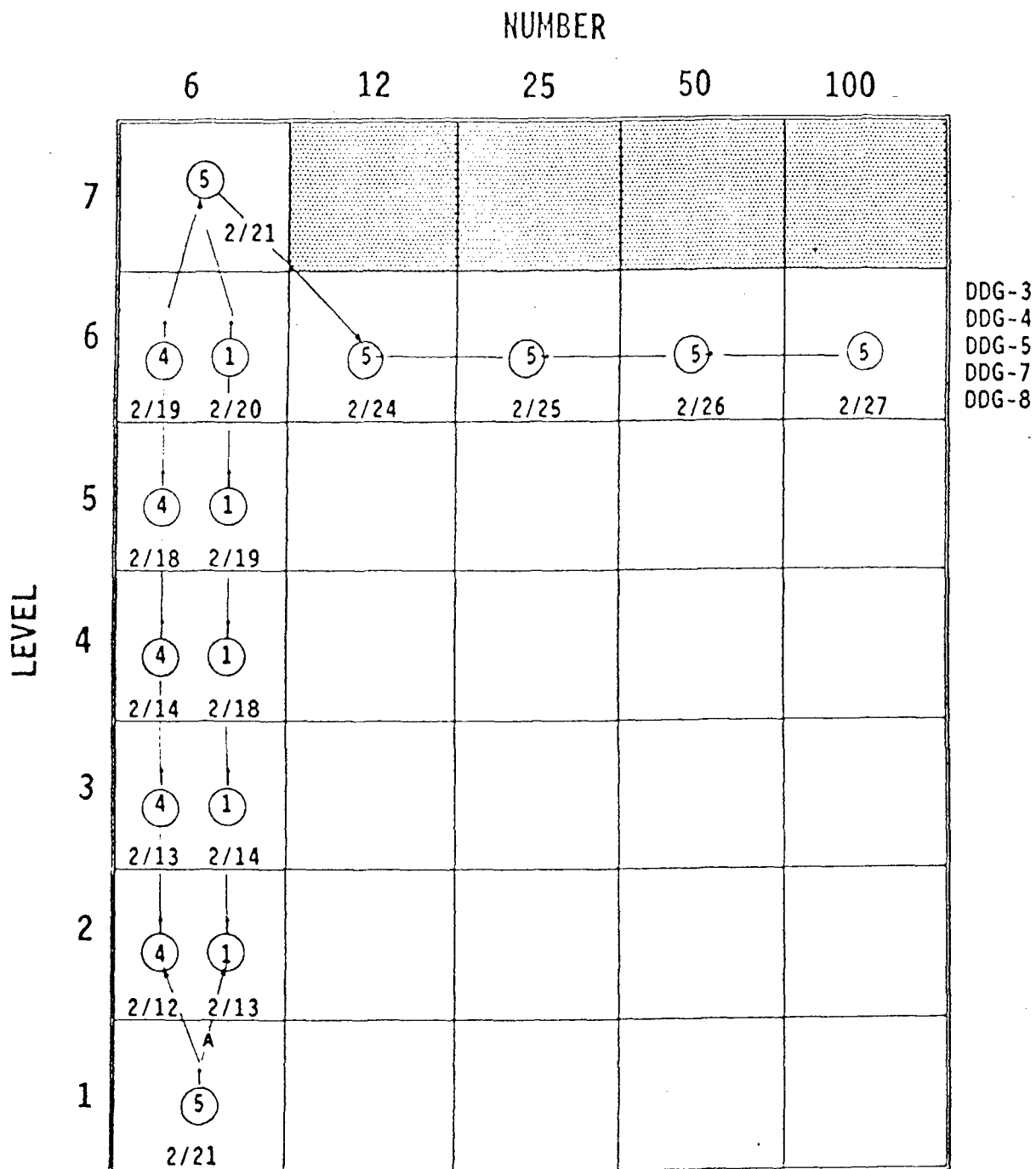


Figure E-31. Group DDG, January-February 1992, 1-M Distance, Modified Muff.
 a. Subject DDG-5 not exposed on 2/12/92 due to lung congestion. Started next exposure on 2/13/92.

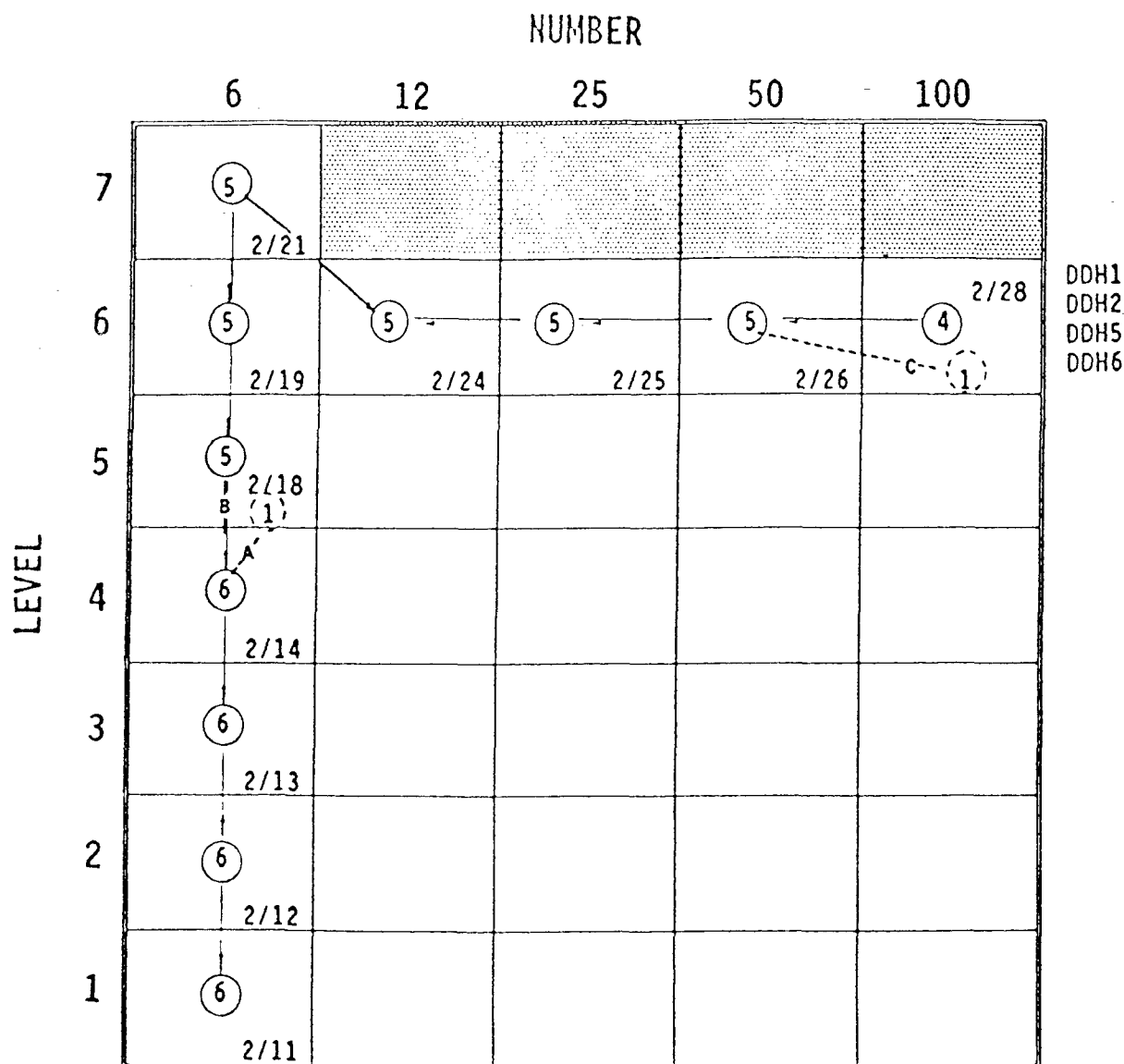


Figure E-32. Group DDH, January-February 1992, 1-M Distance, Modified Muff.

- a. Subject DDH-3 not exposed further because on morning of 18 February, after passing first pre-blast audiogram, he did not pass second audiogram. He continued to test high at 8 kHz from that time on.
- b. Subject DDH-2 did not test at 2 minutes post. No signs of TTS at 20 min or 1 hour.
- c. Subject DDH-4 elected not to be exposed further after condition 6/50.

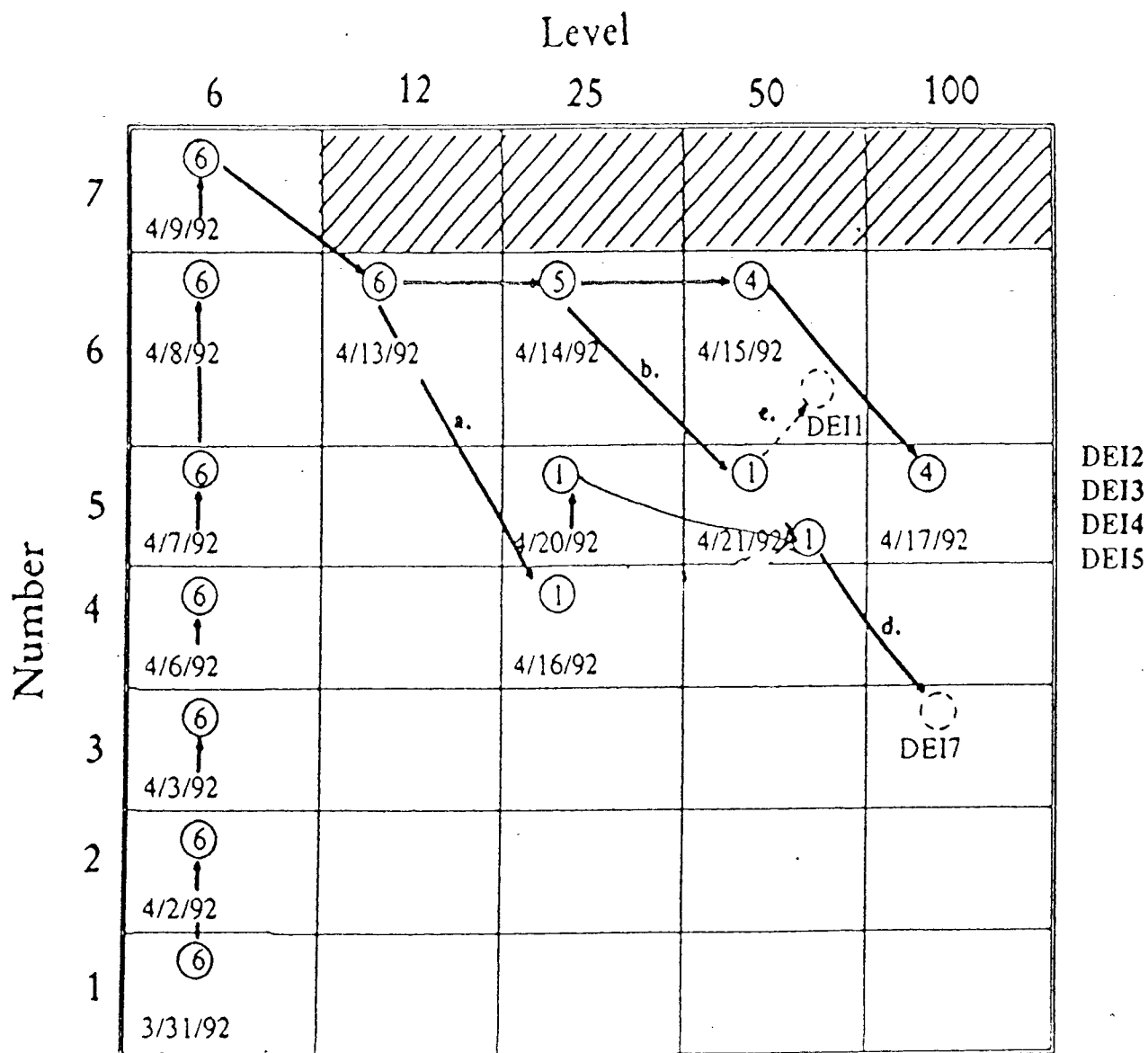


Figure E-33.

Group DEI, March-April 1991, 1-M Distance, Modified Muff.

- Subject DEI-7 auditory failure after 6/12, 30 dB at 6 kHz, then recovered within 1 hr.
- Subject DEI-1 conditional failure at 6 kHz.
- Subject DEI-1 elected to stop exposures after successfully passing 5/50.
- Subject DEI-7 auditory failure after 5/50 at 6 kHz and 8 kHz. PI elected to stop exposure after this condition because TTS exceeded 40 dB.

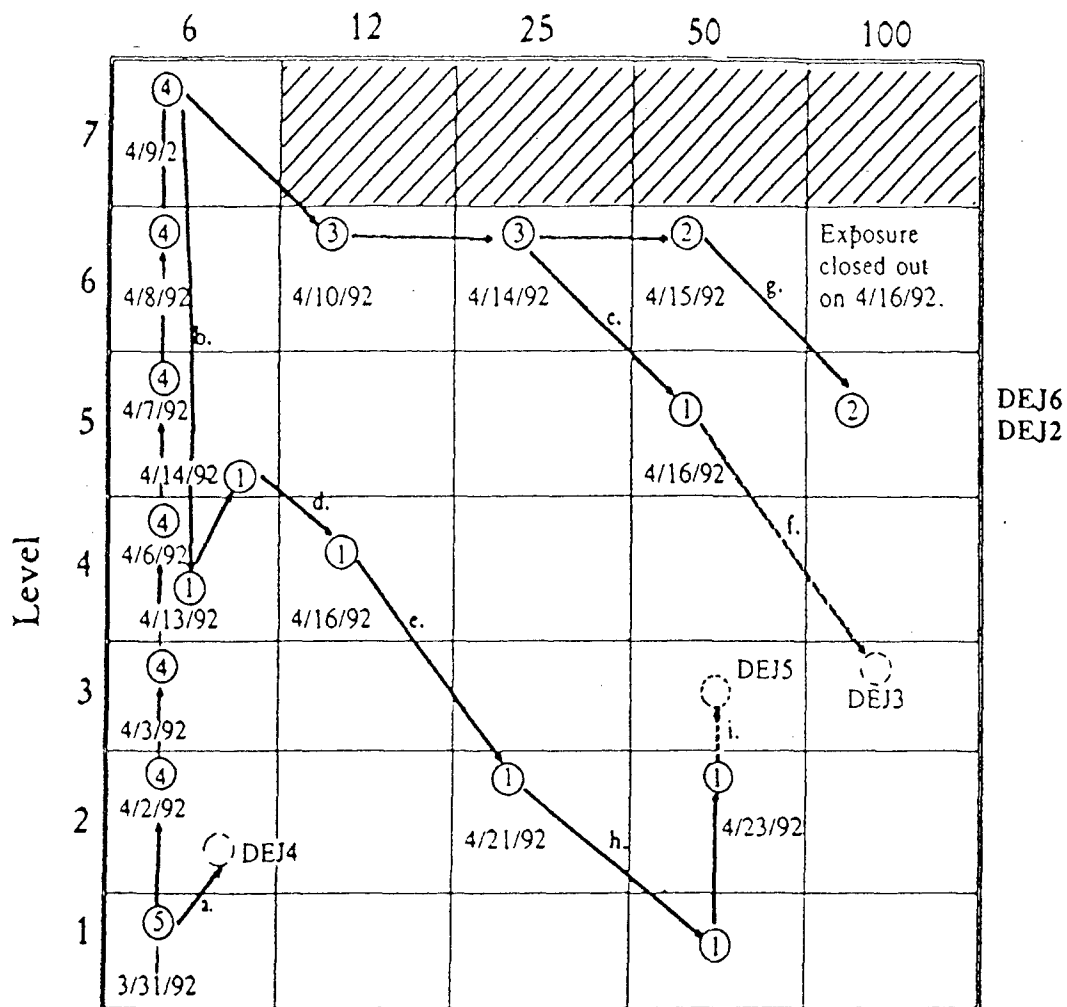


Figure E-34.

Group DEJ, March-April 1992, 1-M Distance, Modified Muff.

- Subject DEJ-4 elected to stop because of personal problems. Elective failure after 1/6.
- Subject DEJ-5 auditory failure after exposure 7/6. PI elected to start at 4/12 because of growth of TTS until the 2-hr point. Stopped after 3 shots at 4/12. Passed at this level so went to 5/6.
- Subject DEJ-3 conditional failure at 2 kHz.
- Subject DEJ-5 conditional failure after 5/7 (only 7 of 12 shots used).
- Subject DEJ-5 auditory failure after 4/12.
- Subject DEJ-3 auditory failure after 5/50 at 2 kHz. Recovered only to within 10 dB of baseline after 24 hr. Further exposure stopped.
- Subject DEJ-6 conditional failure at 8 kHz after 5/100.
- Subject DEJ-5 considered conditional failure at 4 kHz (15 dB TTS) after 2/25.
- Subject DEJ-5 elected to stop after passing 2/50.

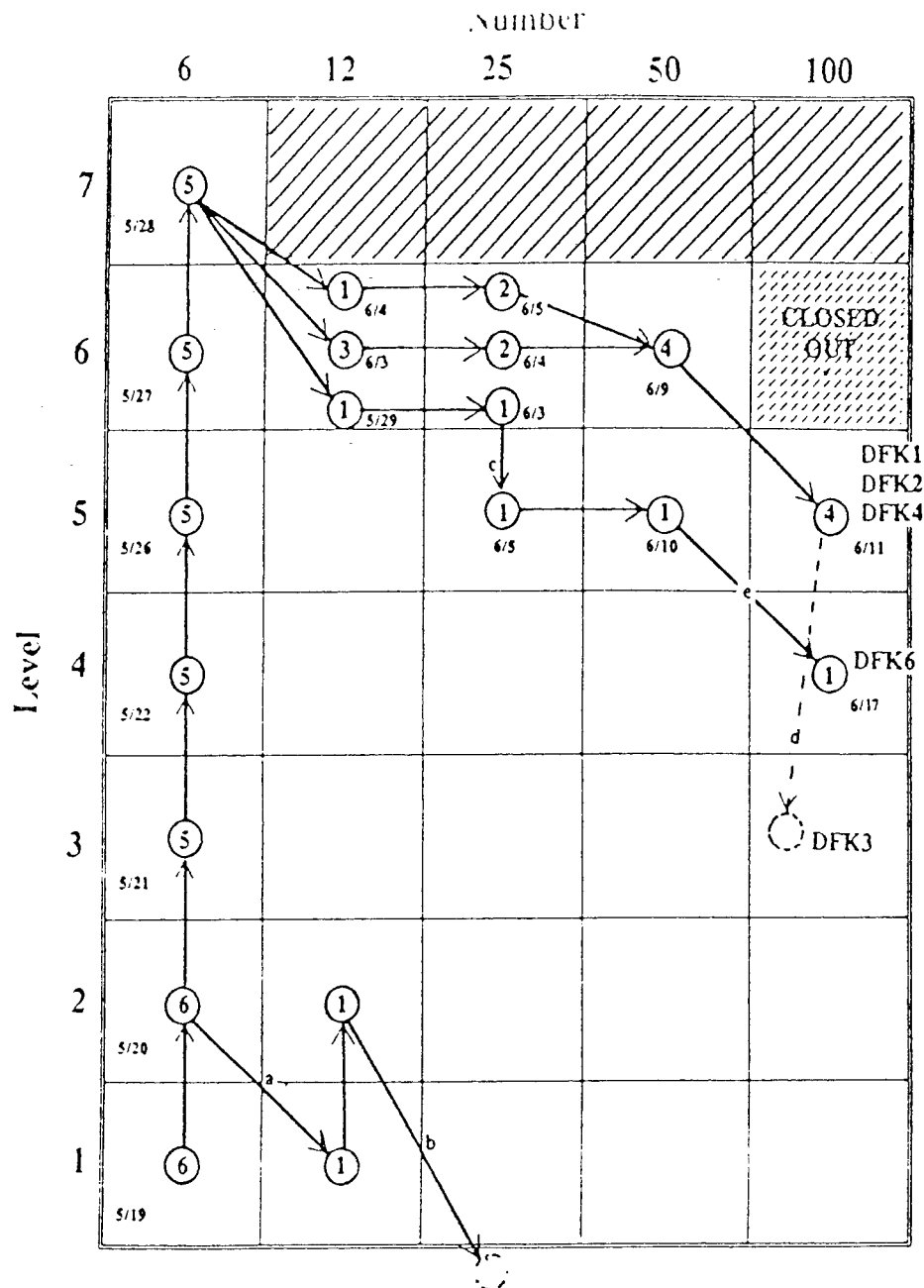


Figure E-35.

Group DFK, May-June 1992, 1-M Distance, Modified Muff.

- Subject DFK-5 was conditional failure at 8 kHz (20 dB) after 2/6.
- Subject DFK-5 was a failure at 2/12. Level 1 protection stopped.
- Subject DFK-6 was auditory failure after 6/25.
- Subject DFK-3 was auditory failure after 5/100. PI stopped further exposure because TTS exceeded 40 dB.
- Subject DFK-6 elected not to go to 5/100 on 11 June because he said he was not up to it. Level 5/100 was then closed out with 11 failures. Subject then went on to and passed condition 4/100 on 17 June.

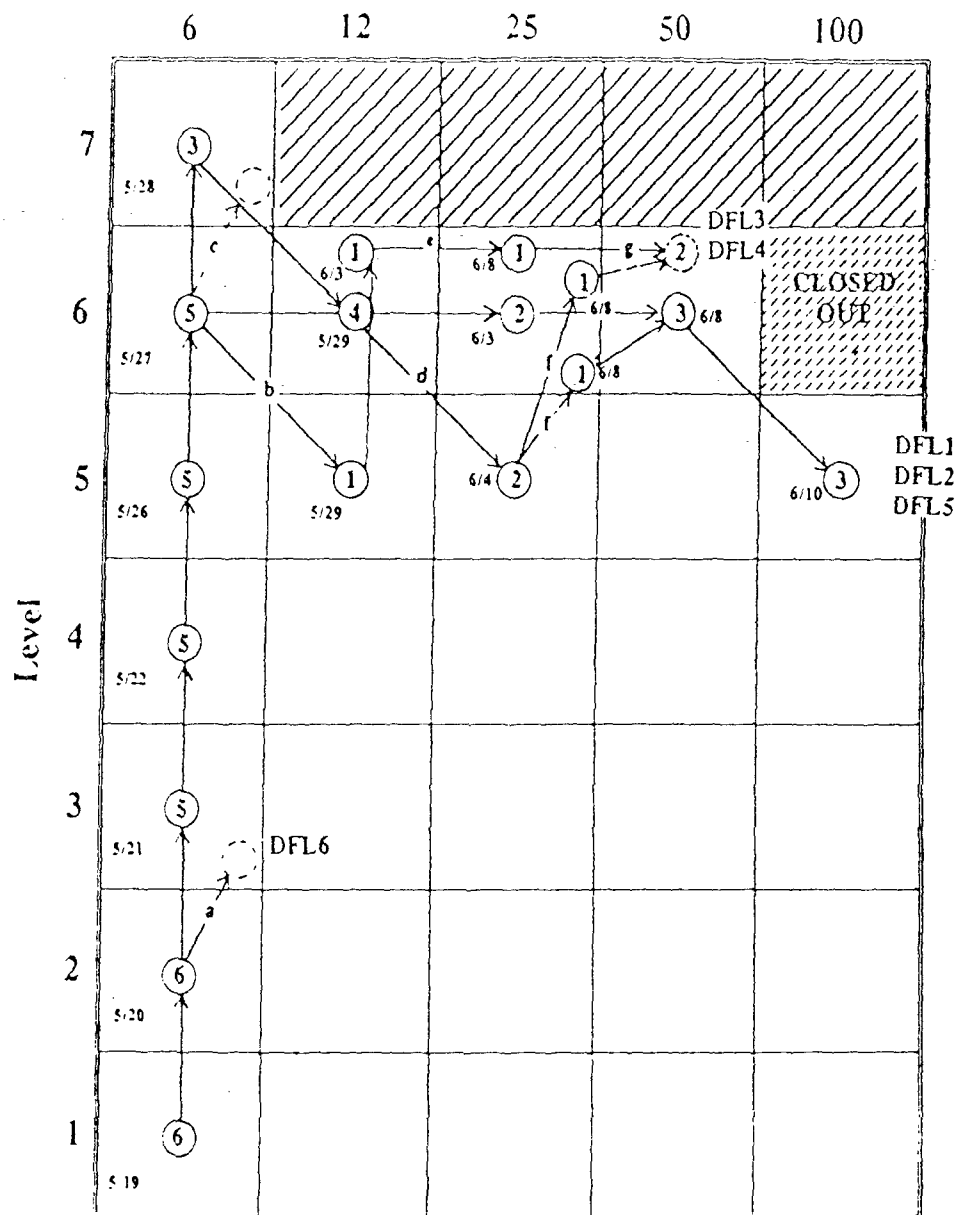


Figure E-36.

Group DFL, May-June 1992, 1-M Distance, Modified Muff.

- a. Subject DFL-6 elected to quit study because of marital considerations.
- b. Subject DFL-3 conditional failure at 4 kHz (19 dB) after Level 6/6.
- c. Subject DFL-4 elected not to be exposed to Level 7/6.
- d. Subjects DFL-1 and DFL-4 conditional failures after condition 6/12.
- e. Subjects DFL-3 passed condition 6/12, clearing conditional failure at 6/6.
- f. Subjects DFL-1 and DFL-4 exposed to condition 6/25 and passed, clearing conditional failures at 6/12.
- g. Subjects DFL-3 and DFL-4 elective failures in that both declined to go to condition 6/50 or even 5/50.

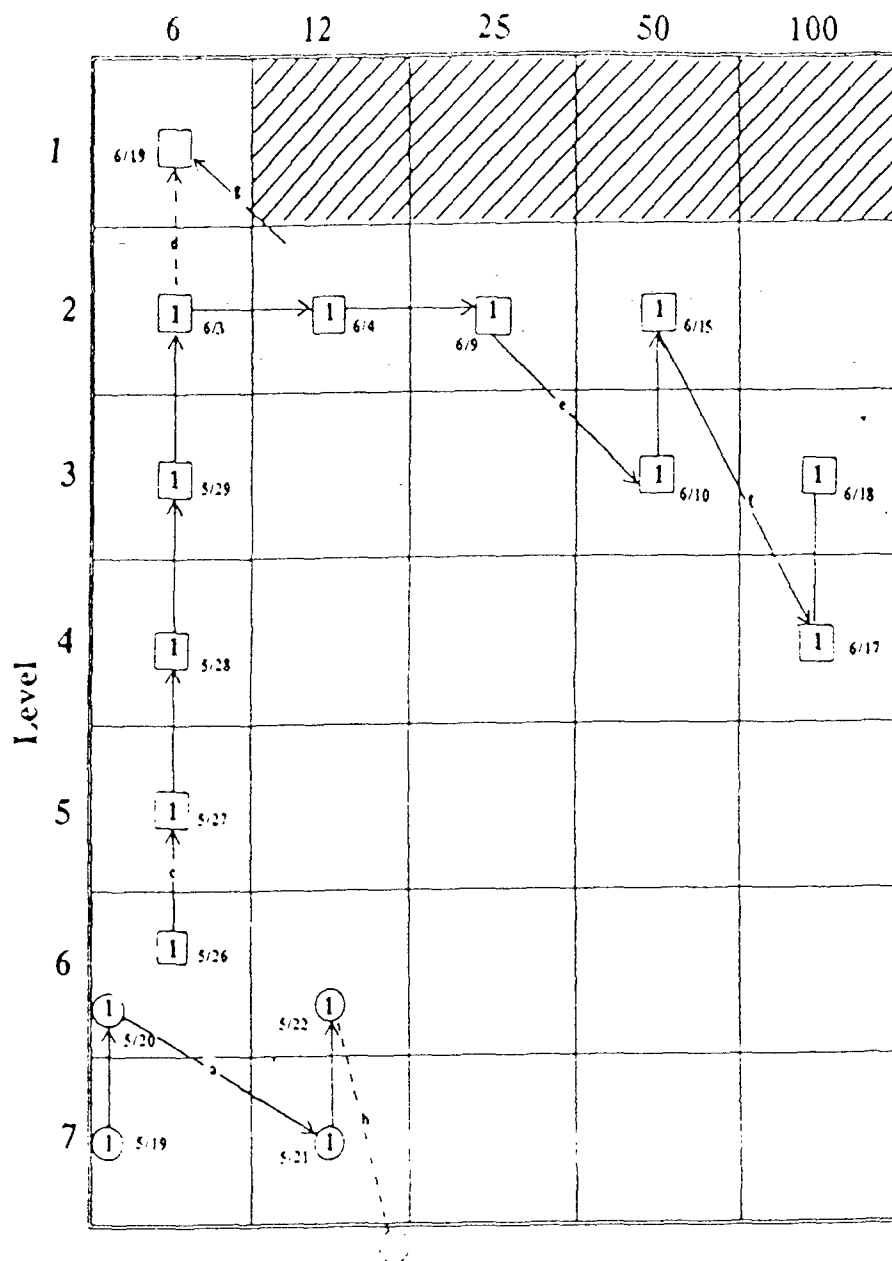


Figure E-37. Subject DFK-5, May-June 1992, 1-M Distance, Modified Muff.

- a. DFK-5 was a conditional failure at 8 kHz (20 dB) after 6/2.
- b. DFK-5 was an auditory failure at 2/12. First-level hearing protection stopped.
- c. DFK-5 started second-level hearing protection with condition 2/6.
- d. DFK-5 elected not to go to level 7 with second-level hearing protection at that time. He said he might go later.
- e. DFK-5 was a conditional auditory failure after level 6/25 with second-level hearing protection.
- f. DFK-5 was an auditory failure with second-level protection at 6/50.
- g. DFK-5 elected to finish his exposures at level 7/6. He passed at that condition.

○ = First level hearing protection.
 □ = Second-level hearing protection.

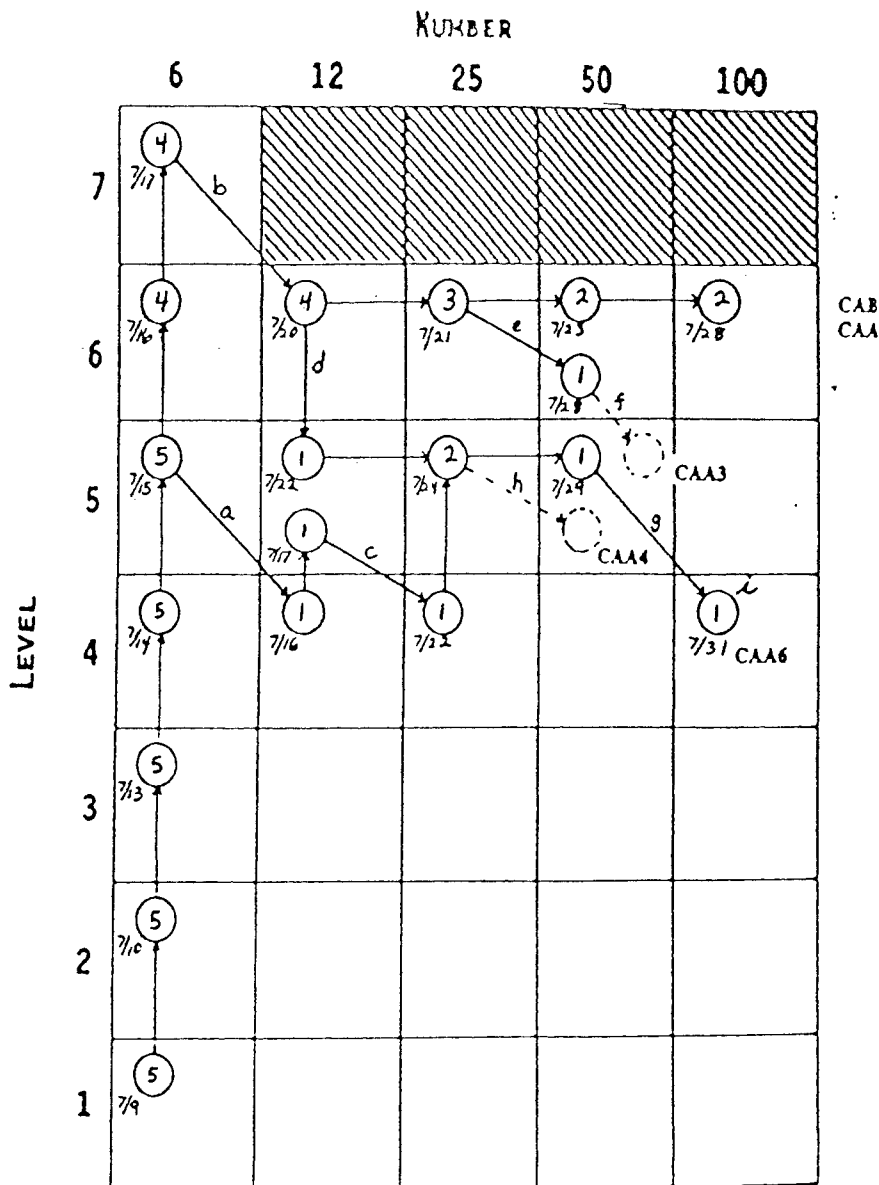


Figure E-38.

Group CAA, July-August 1992, 3-M Distance, Modified Muff.

- a. CAA-4 was a conditional failure after 5/6 with a TTS of 23 dB at 8 kHz.
- b. CAA-3 elected to stop after one shot at condition 7/6.
- c. CAA-4 was a conditional auditory failure after 5/12 with a TTS of 20 dB at 8 kHz.
- d. CAA-6 was an auditory failure after condition 6/12 with a TTS of 25 dB at 3 kHz.
- e. CAA-3 could not meet his baseline prior to his exposure to 6/50 on 23 July.
- f. CAA-3 was a hard auditory failure after 6/50 with a TTS of 54 dB at 6 kHz. PI elected to stop further exposure at this point because of recovery taking longer than 24 hours.
- g. CAA-6 was a conditional auditory failure after 5/50 with a TTS of 17 dB at 8 kHz.
- h. CAA-4 could not meet his baseline at 8 kHz on 28, 29, and 31 July. Therefore, condition 5/50 did not occur. On 30 July, subject indicated that he wanted to quit.
- i. CAA-6 was a conditional auditory failure after 4/100 with a TTS of 19 dB at 2 kHz and 18 dB at 6 kHz.

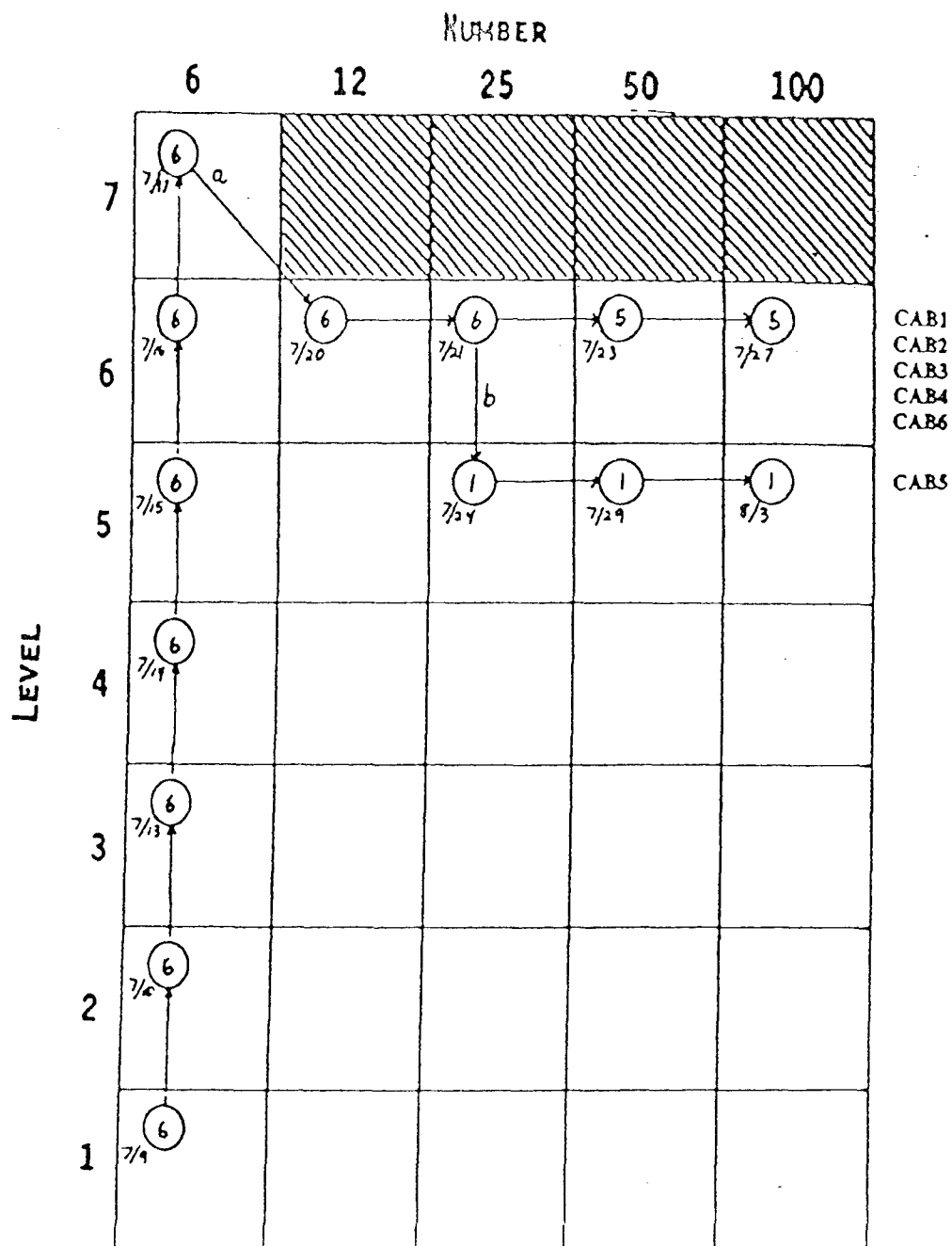


Figure E-39. Group CAB, July-August 1992, 3-M Distance, Modified Muff.

a. CAB-6 was exposed to only 1 shot and subject CAB-3 was exposed to only 2 shots at condition 7/6. Both elected to leave the pad early because of the discomfort of the level 7 shot.

b. CAB-5 was an auditory failure after 6/25 with a TTS of 36 dB at 8 kHz.

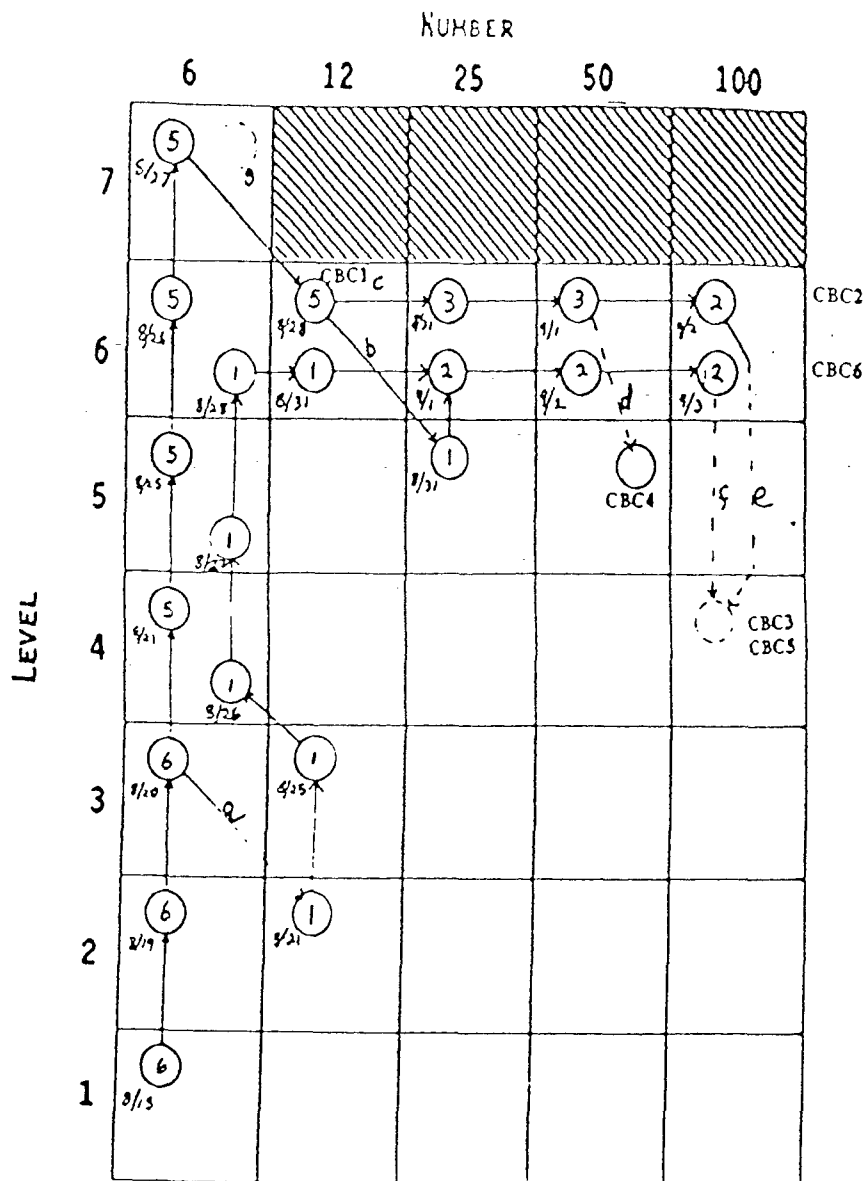


Figure E-40.

Group CBC, August-September 1992, 3-M Distance, Modified Muff.

- a. CBC-6 was a conditional auditory failure after condition 3/6 with a TTS of 19 dB at 6 kHz.
- b. CFC-5 was a conditional auditory failure after condition 6/12 with a TTS of 20 dB at 3 kHz.
- c. CBC-1 on August 31, elected to quit further exposure because of overall anxiety about his well being.
- d. CBC-4 was an auditory failure after condition 6/50 with a TTS of 44 dB at 3 kHz and 34 dB at 4 kHz. This subject was not exposed further because his hearing at 3 kHz took longer than 24 hours to return to normal.
- e. CBC-3 was an auditory failure after condition 6/100 with a TTS of 45 dB at 8 kHz. He recovered to his baseline in 48 hr so further exposure was stopped because his recovery was taking longer than 24 hr. His TTS at 24 hr was 10 dB at 8 kHz.
- f. CBC-5 was an auditory failure after condition 6/100 with a TTS of 26 dB at 4 kHz at the 2-minute test and a TTS of 42 dB at 4 kHz at the 20 minute test. While recovery was complete at 24 hr, the fact that the TTS grew with time and was more than 40 dB resulted in the PI terminating further exposure.
- g. CBC-6, after passing condition 6/100, was given the option of being exposed to condition 7/6. He declined to be exposed to this condition, therefore, he should be considered an elective failure for condition 7/6.

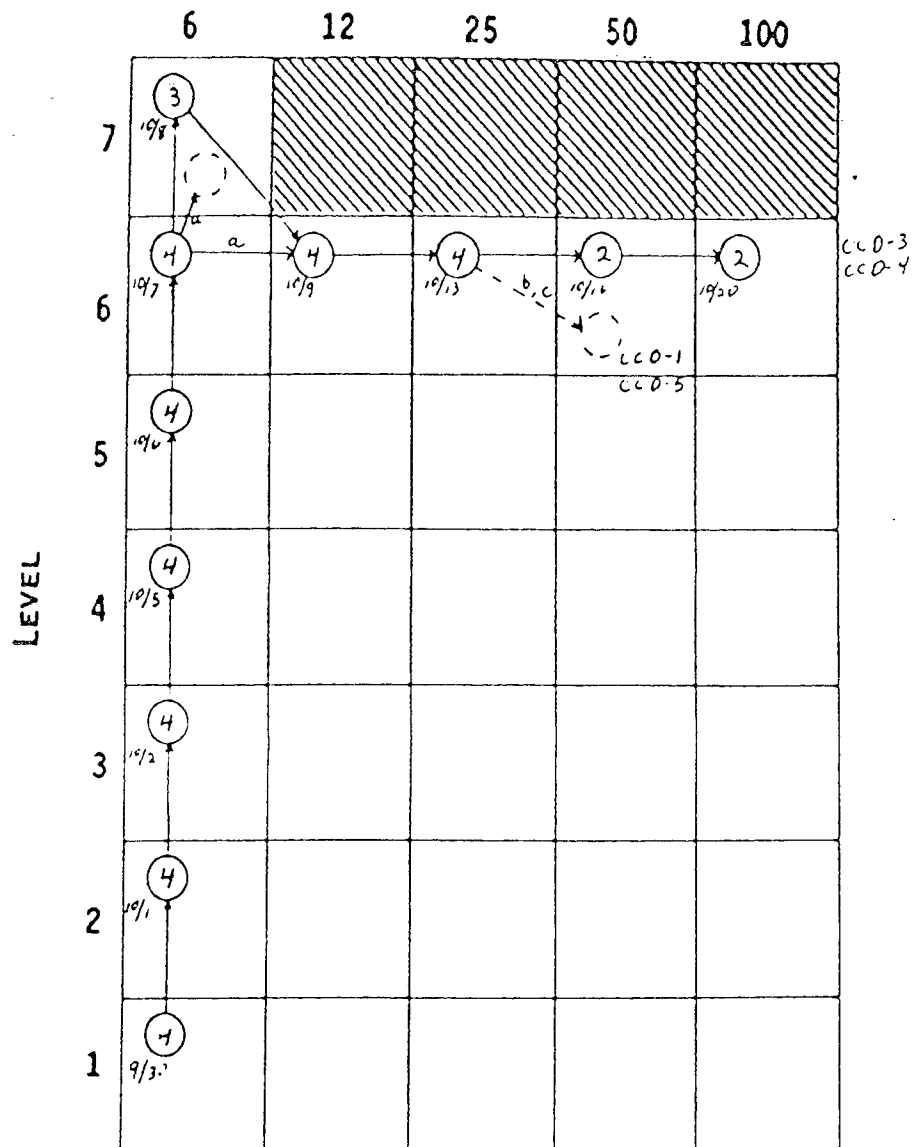


Figure E-41. Group CCD, September-October 1992, 3-M Distance, Modified Muff.

- a. CCD-1 did not go to level 7/6 on 8 October because of stomach cramps. He elected not to go to 7/6 on 20 October.
- b. CCD-5 elected to stop further exposures after condition 6/25 due to personal problems.
- c. CCD-1 elected to stop further exposures after condition 6/25.

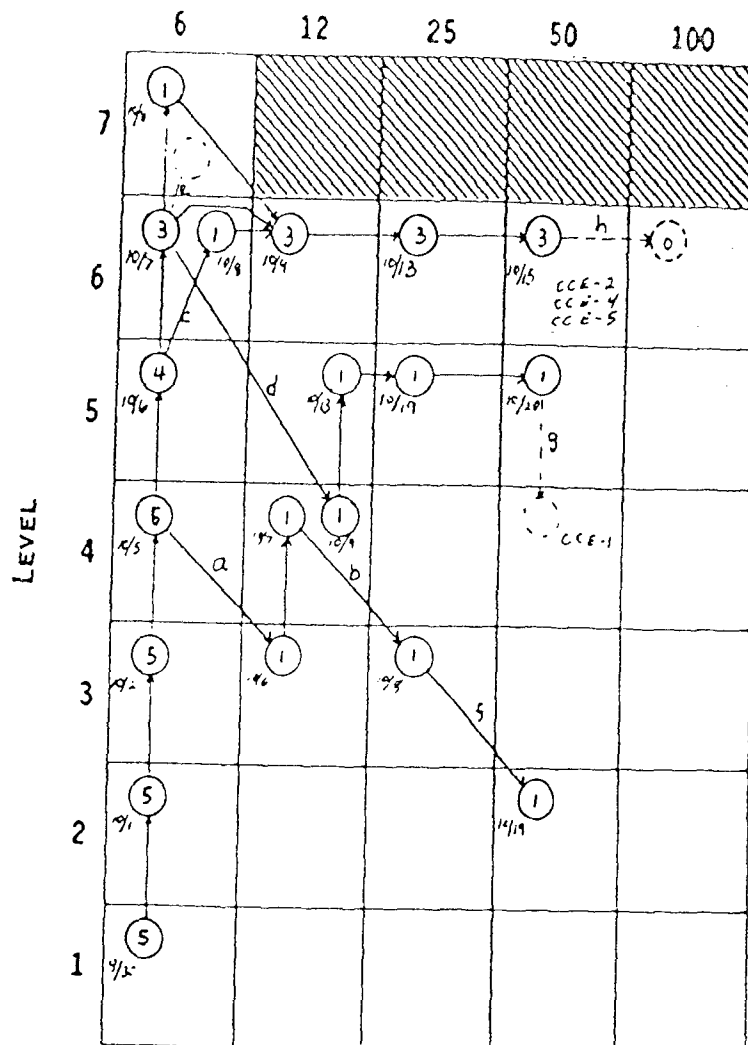


Figure E-42.

Group CCE, September-October 1992, 3-M Distance, Modified Muff.

- CCE-3 was a conditional auditory failure after condition 4/6 with a TTS of 17 dB at 8 kHz after the 20-minute test.
- CCE-3 was a conditional failure after condition 4/12 with a TTS of 16 dB at 8 kHz at the 1-hr test.
- CCE-2 could not meet his baseline at 1 kHz in his right ear. He was given Actifed and his exposure to condition 6/6 was delayed.
- CCE-1 was an auditory failure after 6/6. He had a TTS of 28 dB at 6 kHz at the 20 minute test.
- CCE-4 elected not to be exposed to level 7/6.
- CCE-3 was a conditional auditory failure after 3/25 with a TTS at 8 kHz that grew to a level of 21 dB at 1 hr.
- CCE-1 was an auditory failure after exposure to 5/50. He had a TTS of 28 dB at 3 kHz. Because of problems at home (sick grandmother) he elected to stop further exposures at this time.
- CCE-2, CCE-4, CCE-5 elected not to be exposed to condition 6/100 because of their concerns of the difficulty in enduring such an exposure.

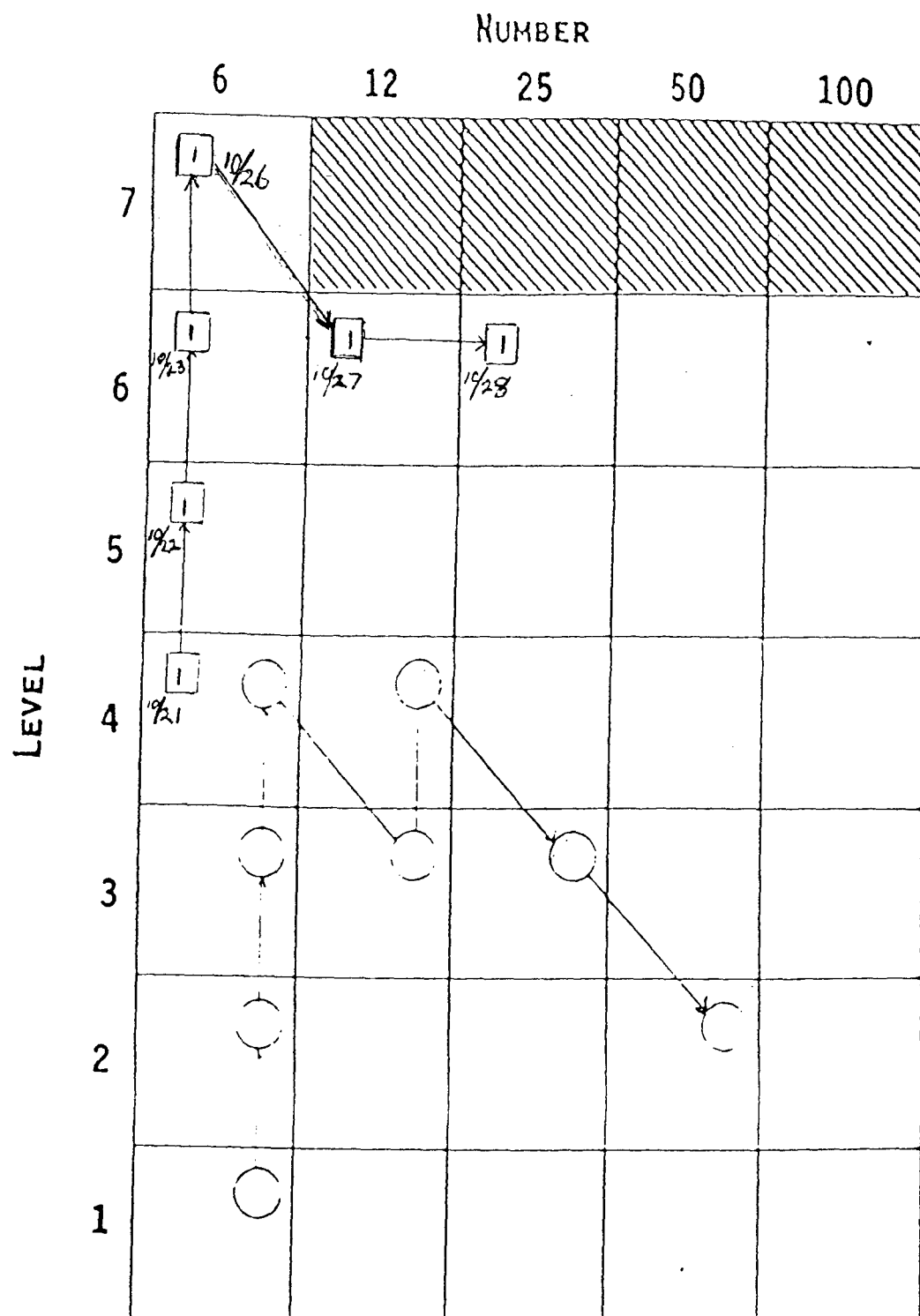


Figure E-43. Subject CCE-3, October 1992, 3-M Distance, Modified Muff.
a. CCE-3 second-level hearing protection.

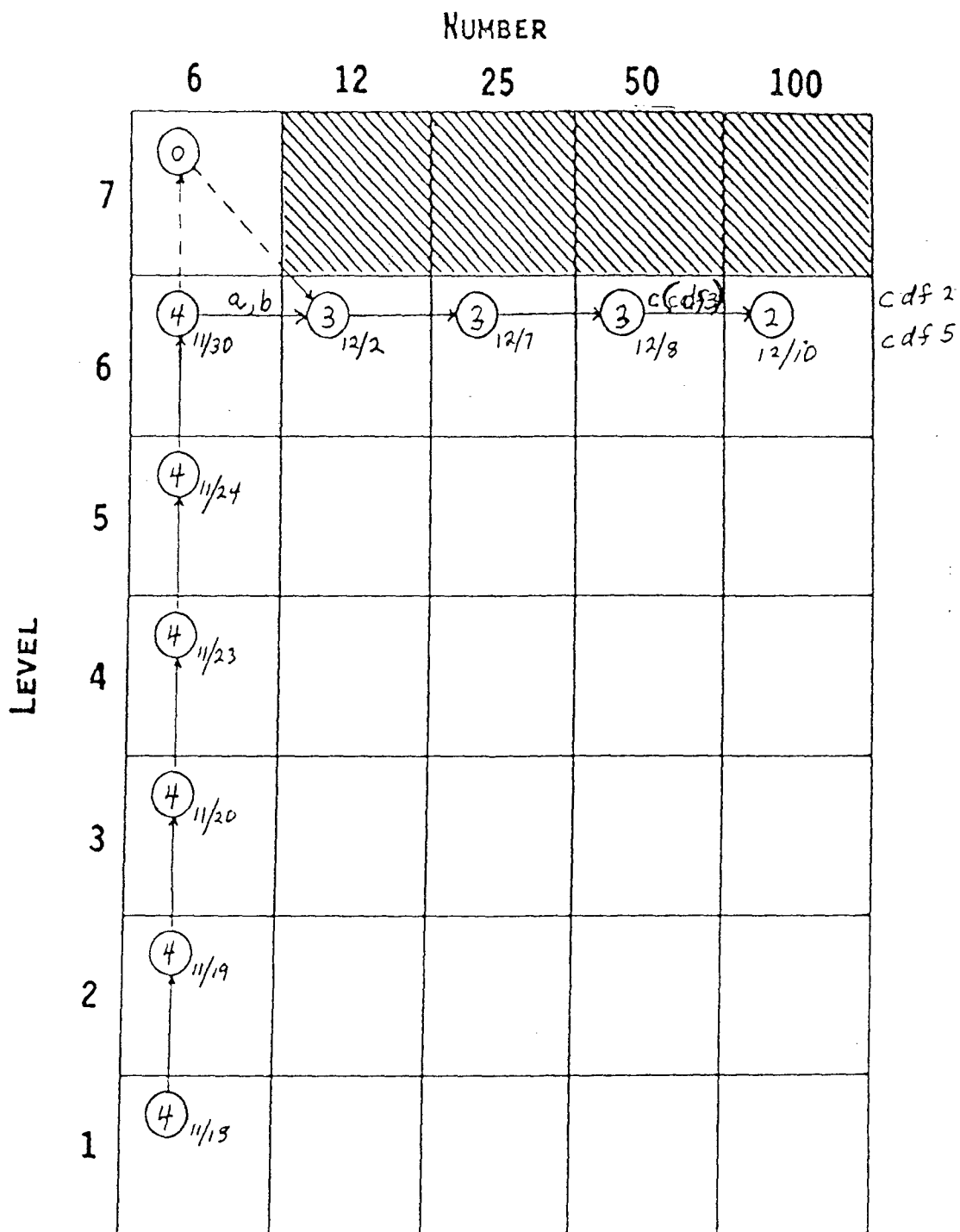


Figure E-44. Group CDF, November-December 1992, 3-M Distance, Modified Muff.

a. CDF-4 was dropped from the study after Level 6/6 because of anemia.

b. CDF-2, CDF-3, and CDF-5 elected not to be exposed to Level 7.

c. CDF-3 elected not to be exposed to Level 6/100.

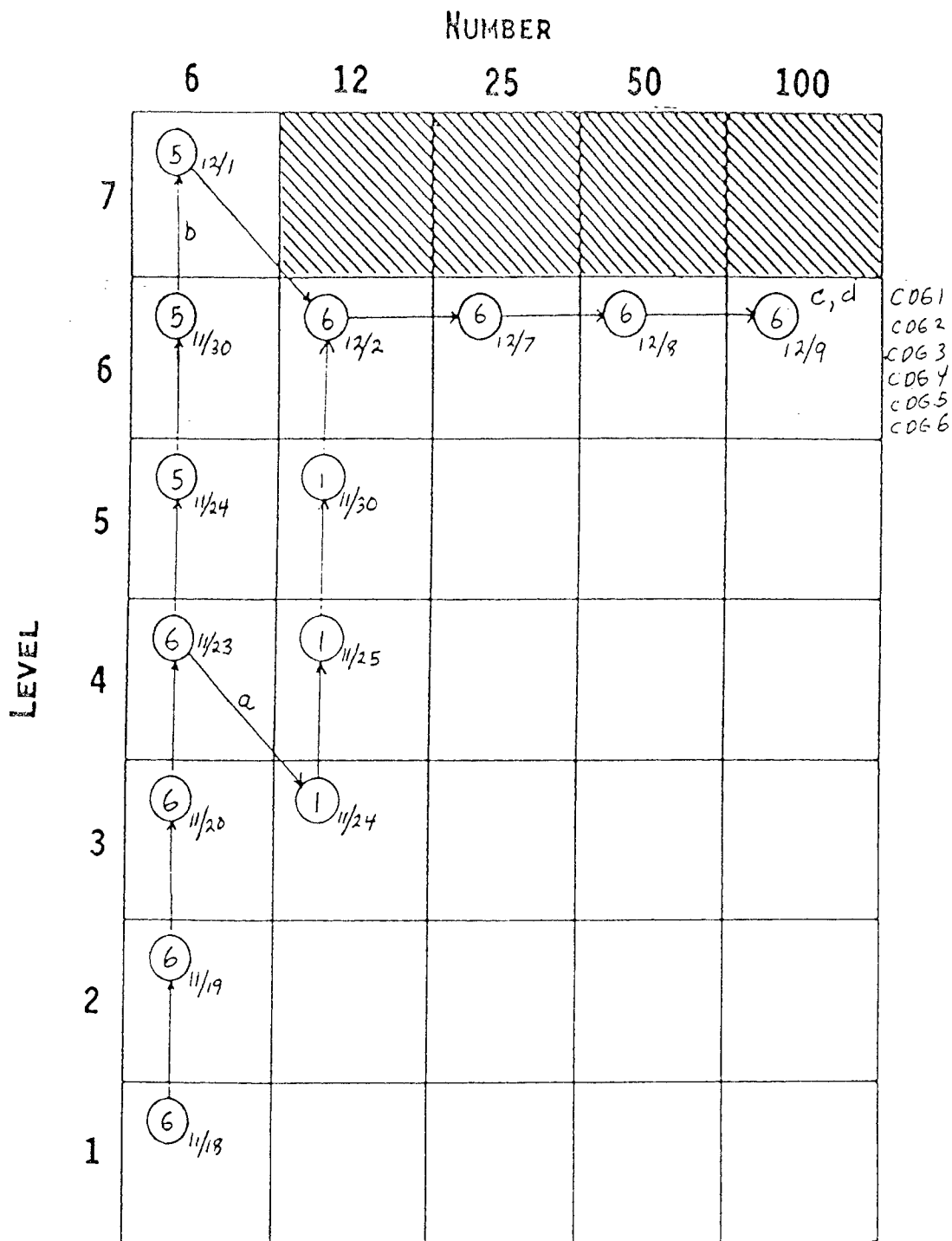


Figure E-45. Group CDG, November-December 1992, 3-M Distance, Modified Muff.

- a. CDG-3 was a conditional failure after 4/6 with a TTS of 23 dB at 8 kHz.
- b. CDG-2 elected to leave the pad after one exposure at level 7/6.
- c. CDG-2 elected to stop exposures after 59 shots during level 6/100.
- d. CDG-3 elected not to go to level 7 after exposure to level 6/100.

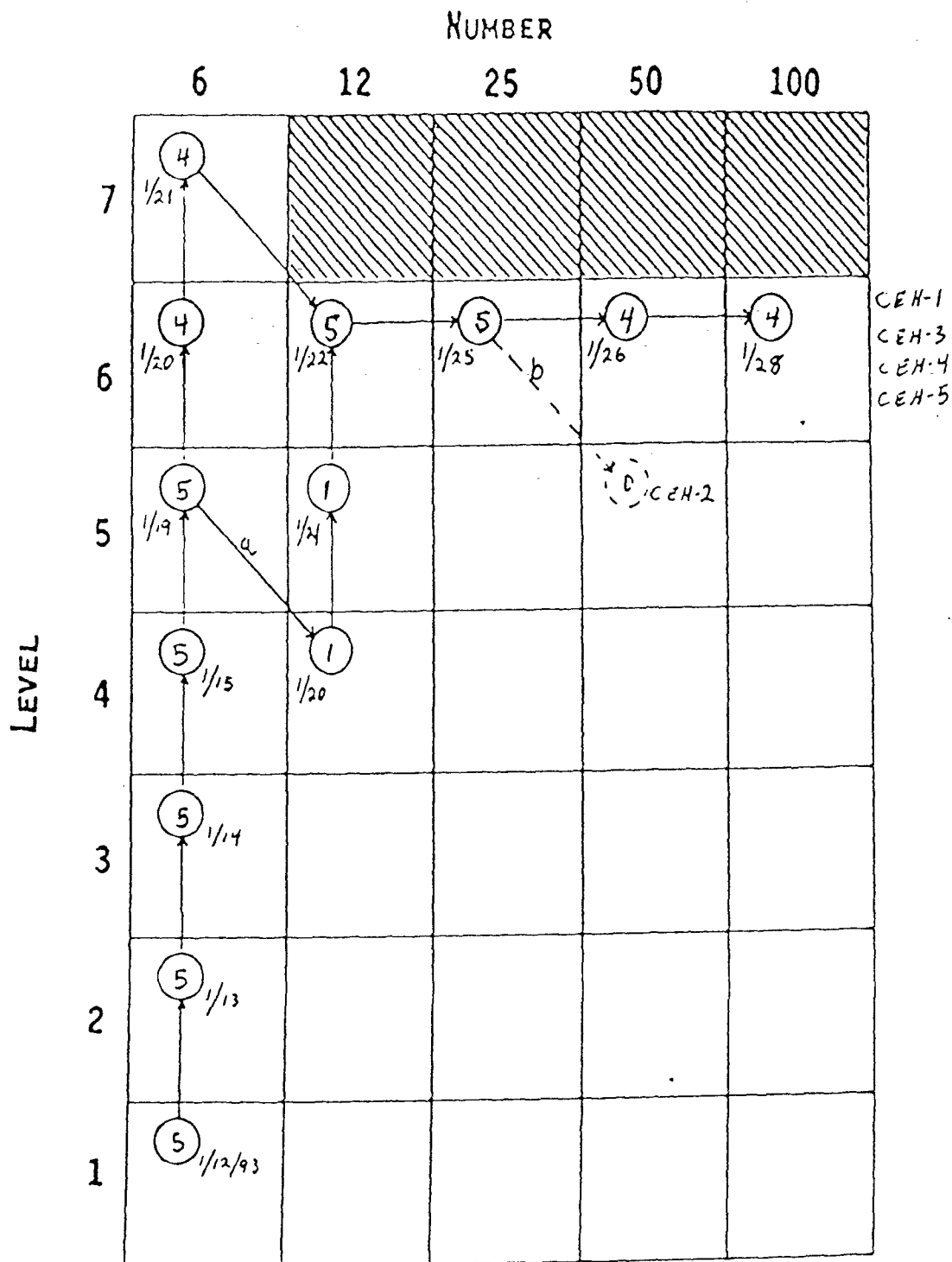


Figure E-46.

Group CEH, January-February 1993, 3-M Distance, Modified Muff.

- a. CEH-2 was considered a conditional auditory failure after condition 5/6 with an elevated threshold across all frequencies.
- b. CEH-2 elected to leave the pad after shot 9 of condition 6/25. He had a TTS of 13 dB at 500 Hz and 2000 Hz at 18 minutes post exposure. He was considered a probable conditional auditory failure. This subject elected to stop further exposures.

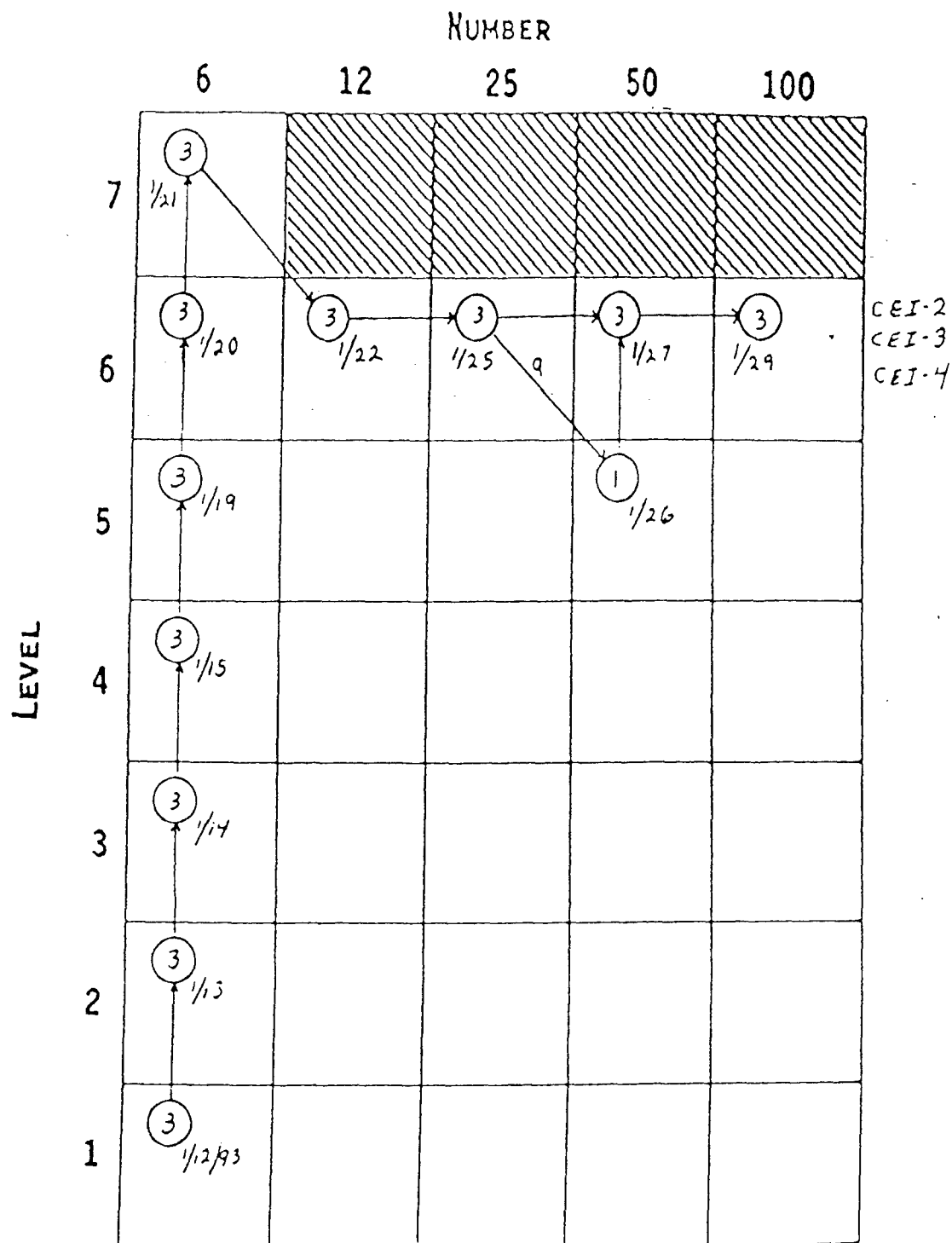


Figure E-47. Group CEI, January-February 1993, 3-M Distance, Modified Muff.
a. CEI-4 had a TTS of 16 dB at 8 kHz after condition 6/25.

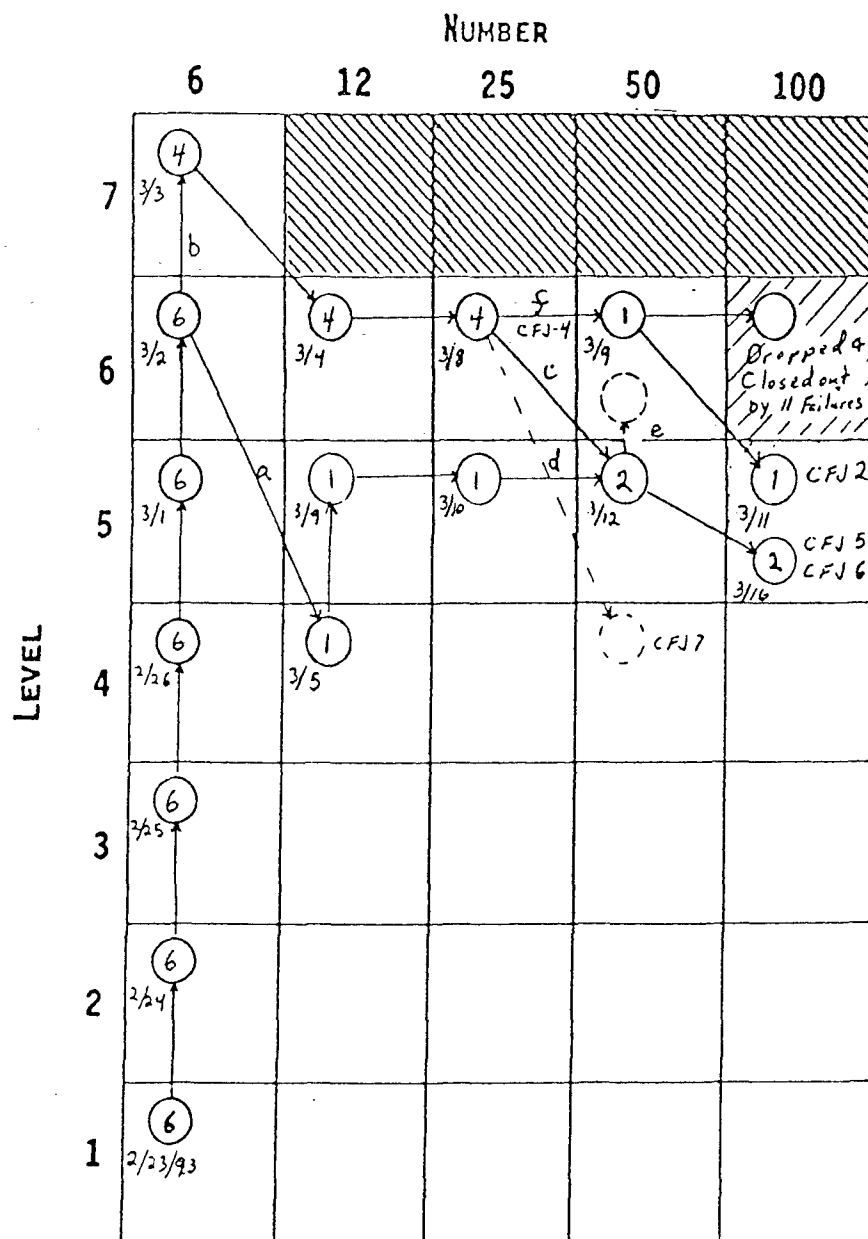


Figure E-48.

Group CFJ, February-March 1993, 3-M Distance, Modified Muff.

- CFJ-5 was an auditory failure with a TTS at 8 kHz of 49 dB.
- CFJ-5 was administratively dropped because he was arrested using controlled substances.
- CFJ-6 was a conditional auditory failure after 6/25 with a TTS of 17 dB at 2 kHz.
- CFJ-7 was a failure after condition 6/25 with a TTS at 2 minutes of 25 dB at 4 kHz. This TTS grew to 43 dB at 1 hr before recovery started. While recovery was complete within 24 hr, the subject was dropped from further exposure due to the TTS growth pattern.
- CFJ-6 elected not to go to 6/50 after passing 5/50. He did go to condition 5/100.
- CFJ-4 complained of a sore throat after 6/25. Dr. Neal of Lovelace recommended that he not be exposed again until his throat cleared. The subject said he would blast again only if his throat would not be bothered. The PI considers him an elective failure.

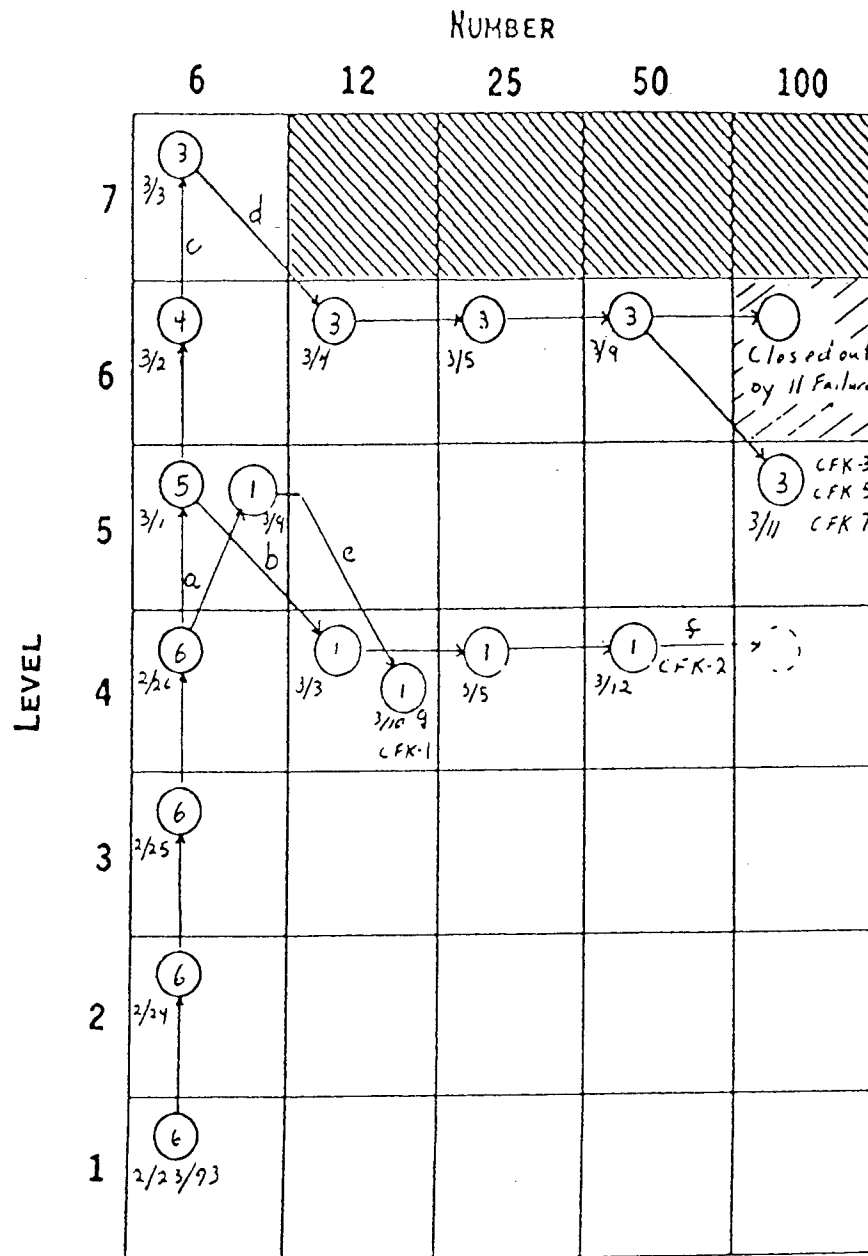


Figure E-49.

Group CFK, February-March 1993, 3-M Distance, Modified Muff.

- a. CFK-1 could not meet his baseline at 3 kHz and 8 kHz. Met his baseline on 3/9 and was exposed at that time.
- b. CFK-2 was an auditory failure with a TTS at 4 kHz of 21 dB at 2 min. and 27 dB at 20 min.
- c. CFK-6 was administratively dropped for being arrested for using controlled substances.
- d. CFK-3 was a conditional auditory failure with a TTS of 18 dB at 8 kHz.
- e. CFK-1 was a conditional auditory failure after 5/6 with a TTS of 17 dB at 3 kHz.
- f. CFK-2 elected not to be exposed to condition 5/100.
- g. CFK-1 could not consistently meet his baseline after condition 4/12. He would meet it sometimes and not others. He was dropped on 3/15/93.

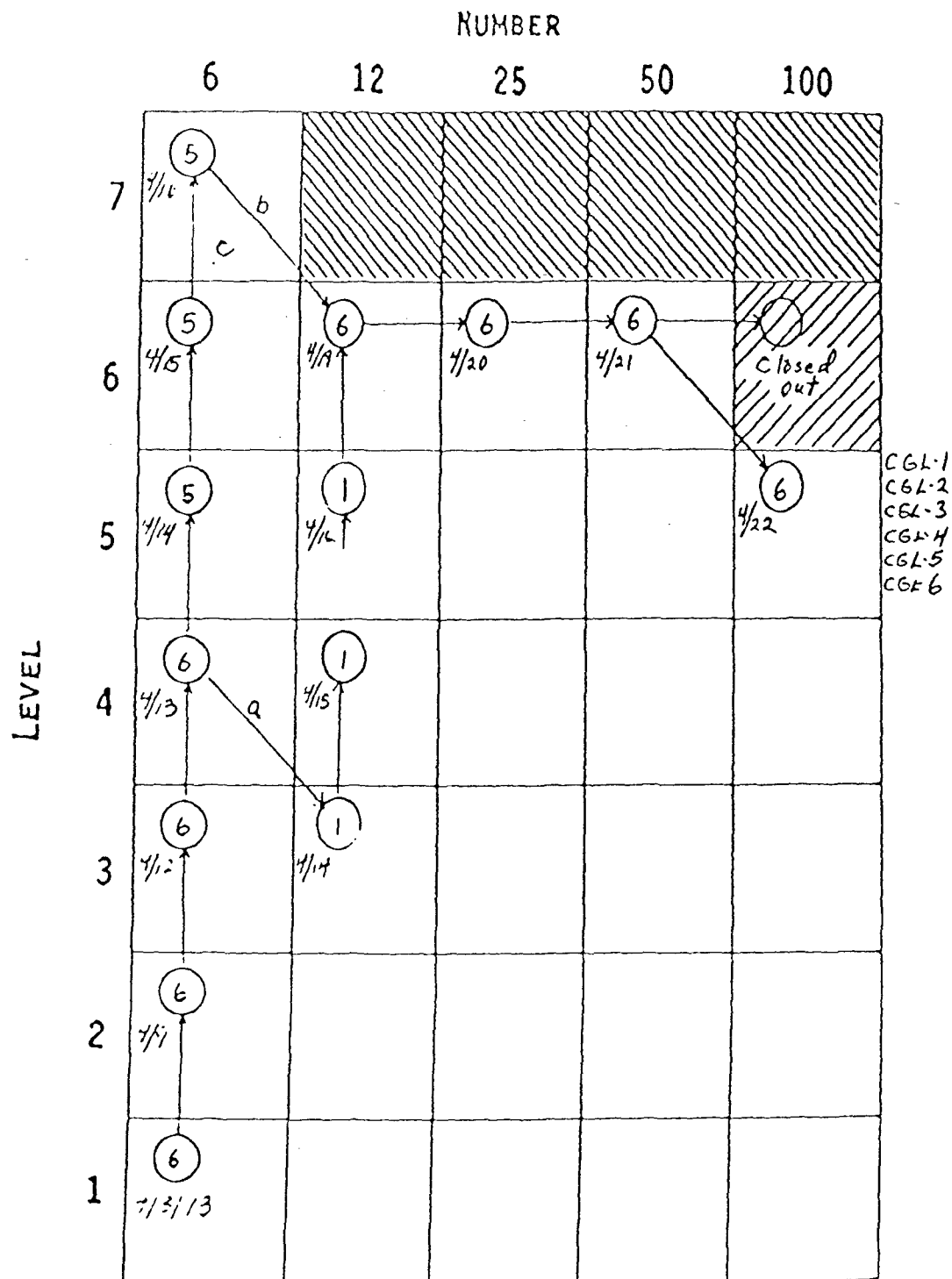


Figure E-50.

Group CGL, March-April 1993, 3-M Distance, Modified Muff.

- a. CGL-4 was a conditional auditory failure after condition 4/6 with a TTS of 22 dB at 4 kHz and 20 dB at 3 kHz.
- b. CGL-3 was a conditional auditory failure after condition 7/6 with a TTS of 21 dB at 8 kHz.
- c. CGL-4 elected not to be exposed to condition 7/6.

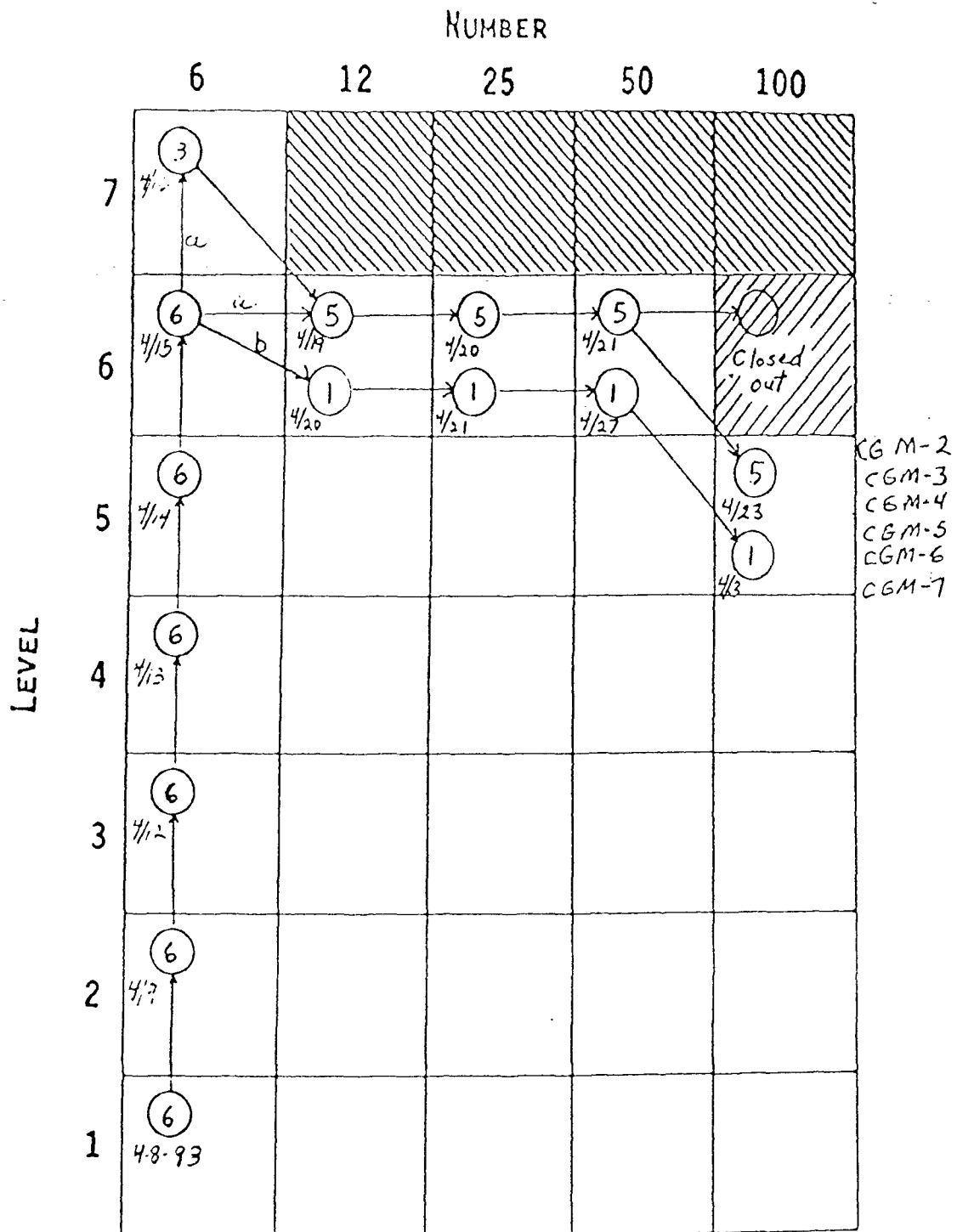


Figure E-51. Group CGM, March-April 1993, 3-M Distance, Modified Muff.

a. CGM-1, CGM-2, and CGM-5 elected not to be exposed to condition 7/6. They all continued with condition 6/12.

b. CGM-1 was elevated at 4 kHz at his right ear during his preblast audiogram. This was likely due to his cold and general mild middle ear infection. He was not exposed on April 19.

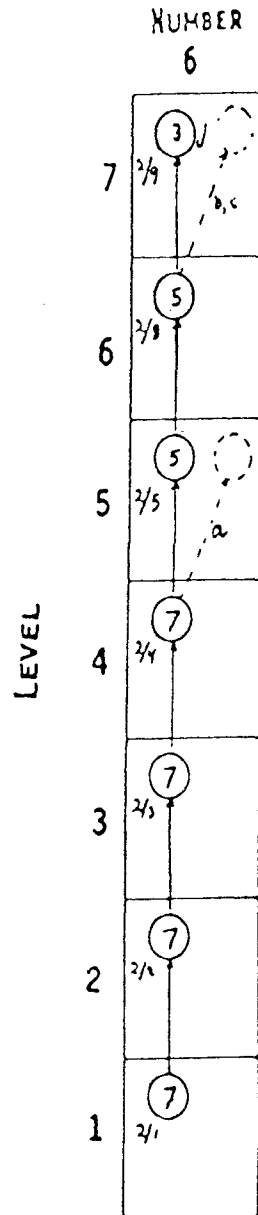


Figure E-52.

No-Countdown Groups CEH and CEI, February 1993, 3-M Distance, Modified Muff.

- a. CEH-4 and CEH-5 stopped after condition 4/6 because both had ringing in their right ears immediately after the exposure. The ringing quickly disappeared and there were no signs of TTS in these subjects.
- b. CEI-1 elected to stop after exposure to condition 6/6 because of a TTS of 15 dB at 8 kHz.
- c. CEI-3 elected to stop after condition 6/6 because of intermittent ringing and headaches due to exposure to conditions 5/6 and 6/6.
- d. CEI-4 elected to stop after the second shot at condition 7/6. He reported as the reason that the exposure were just "too much."

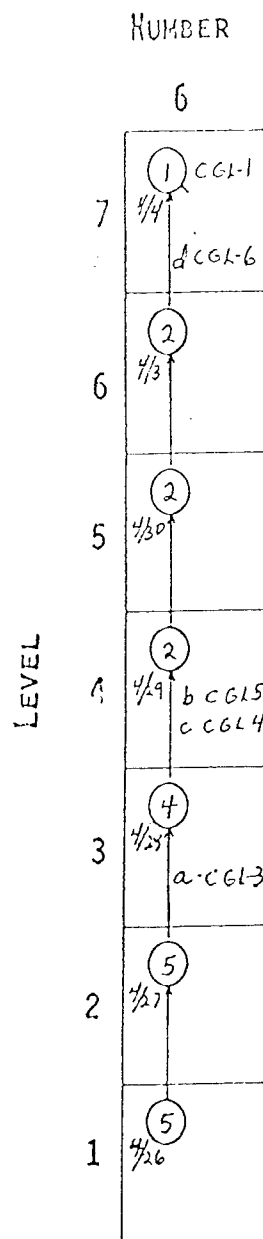


Figure E-53.

No-Countdown Group CGL, April 1993, 3-M Distance, Modified Muff.

- a. CGL-3 elected to stop after level 2. He stated he was too tense waiting for the shot to go off.
- b. CGL-5 was a conditional auditory failure after level 3 with a TTS of 16 dB at 3 kHz.
- c. CGL-5 could not meet his baseline at 6 kHz prior to level 4. Became an elective failure when he declined to continue the next day.
- d. CGL-6 complained that one of the shots especially bothered him after level 6. Was an elective failure for level 7.

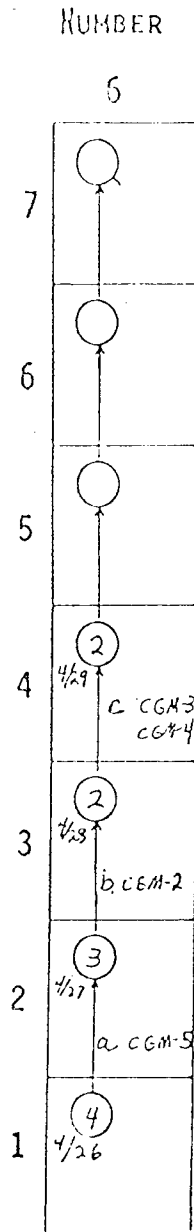


Figure E-54. No-Countdown Groups CGM, April 1993, 3-M Distance, Modified Muff.

- CGM-5 became ill before level 2. Was elevated at several frequencies and did not feel like being exposed. Was also sick the next day and elected to quit at that time.
- CGM-2 elected to stop after level 2. He claimed his ringing was louder with the no-countdown exposure.
- CGM-3 and CGM-4 were elective failures at level 4. CGM-3 stated that the lack of countdown made the exposure harder to bear and he already observed that the stop between level 4 and level 5 was greater. CGM-4 stated he was tired of the study including doing audiograms.

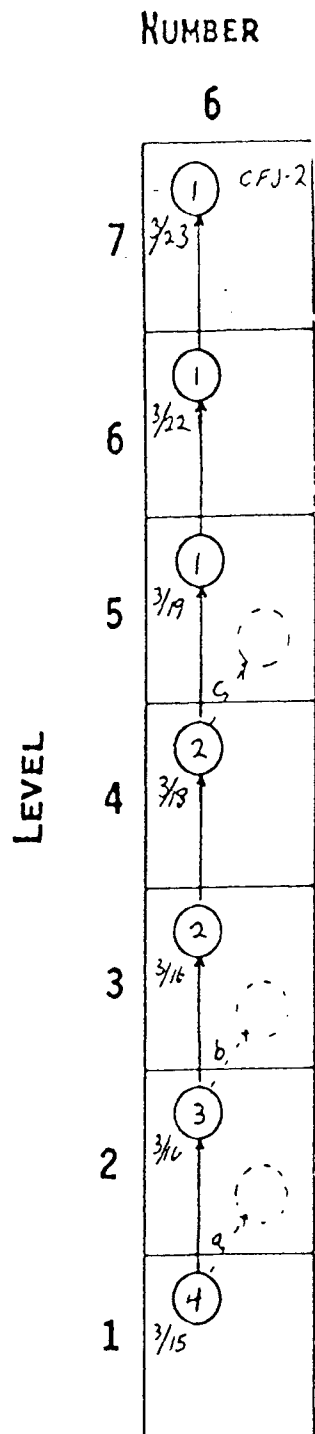


Figure E-55. No-Countdown Group CFK, March 1993, 3-M Distance, Modified Muff.

- a. CFK-7 elected to quit after 1/6.
- b. CFK-3 elected to quit after 2/6.
- c. CFK-5 elected to quit after 4/6.

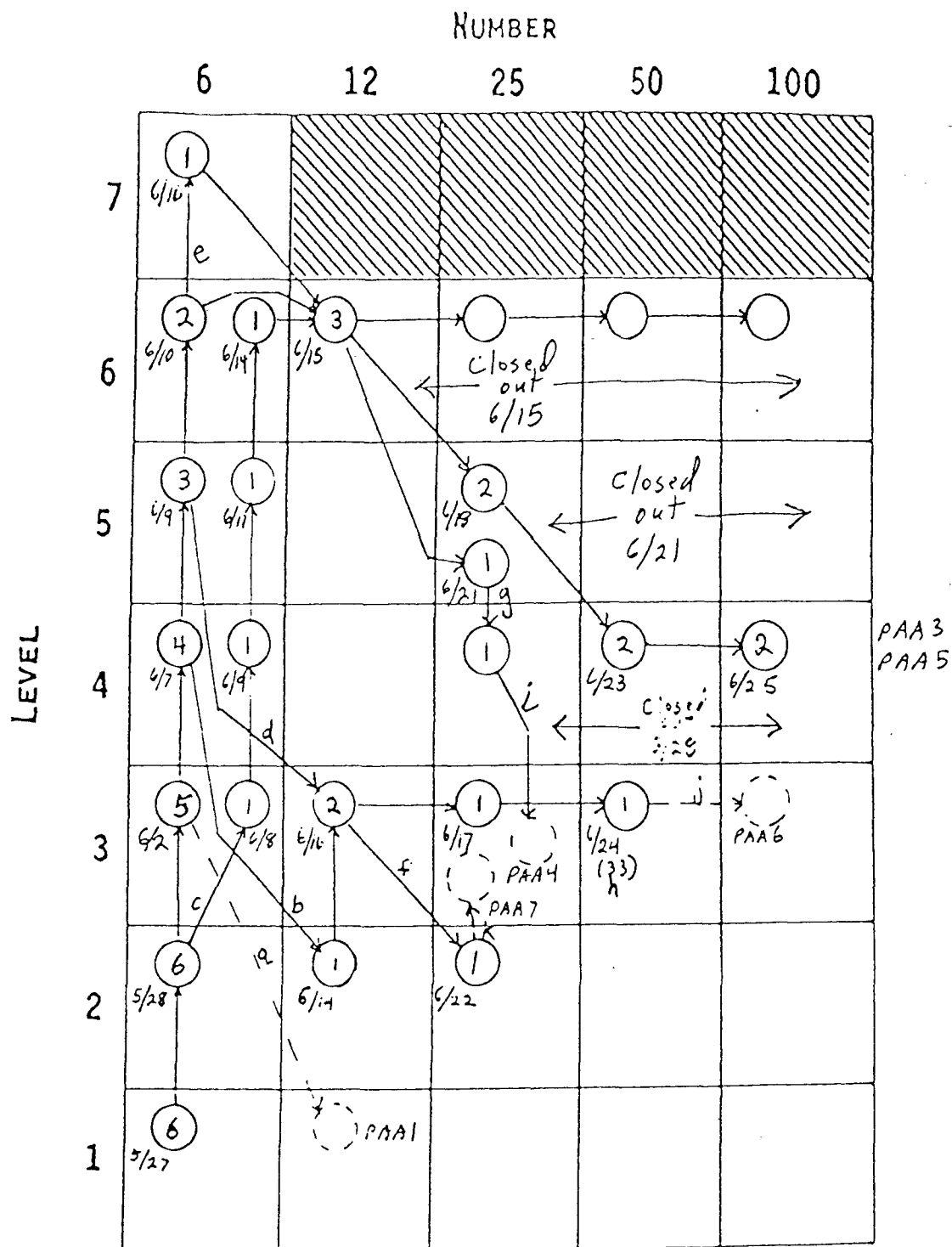


Figure E-56. Group PAA, May-June 1993, 3-M Distance, Perforated Ear Plugs.

Figure E-56. Group PAA, May-June 1993, 3-M Distance, Perforated Ear Plugs
(Continued)

- a. PAA-1 was an auditory failure with a TTS of 32 dB at 6 kHz. This TTS was 13 dB at 24 hr, fully recovered to 0 dB in 48 hr. This subject was dropped from further exposure because of slow recovery.
- b. PAA-6 was an auditory failure with a TTS of 40 dB at 8 kHz. He recovered by 2 hr. This subject had a hematoma in his left ear canal possibly due to E.A.R. foam plug movement.
- c. PAA-3 broke a toe playing soccer and was delayed for several days.
- d. PAA-7 was an auditory failure after 5/6 with TTS of 27 dB.
- e. PAA-4 and PAA-5 elected not to go to level 7. Subject PAA-3 passed level 7 on 16 June.
- f. PAA-7 was a conditional auditory failure with a TTS of 20 dB at 2 kHz.
- g. PAA-4 was an auditory failure with a TTS of 30 dB at 4 kHz after condition 5/25.
- h. PAA-6 stopped after 33 shots at level 3 because of ear pain and ringing. While he stopped exactly at 33 shots because of subject PAA-4, he stated positively he would not have taken 50 shots.
- i. PAA-4 was an auditory failure with a TTS of 46 dB at 2 kHz after condition 4/25. Because of increasing sensitivity with decreasing level, the PI elected not to further expose the subject. In any case, the subject also elected to stop the exposures.
- j. PAA-6 elected to stop further exposures because of concern for his hearing. He also experienced some occasional ringing.
- k. PAA-7 elected to stop further exposures because of concerns for his hearing and the fact that he had some ringing.

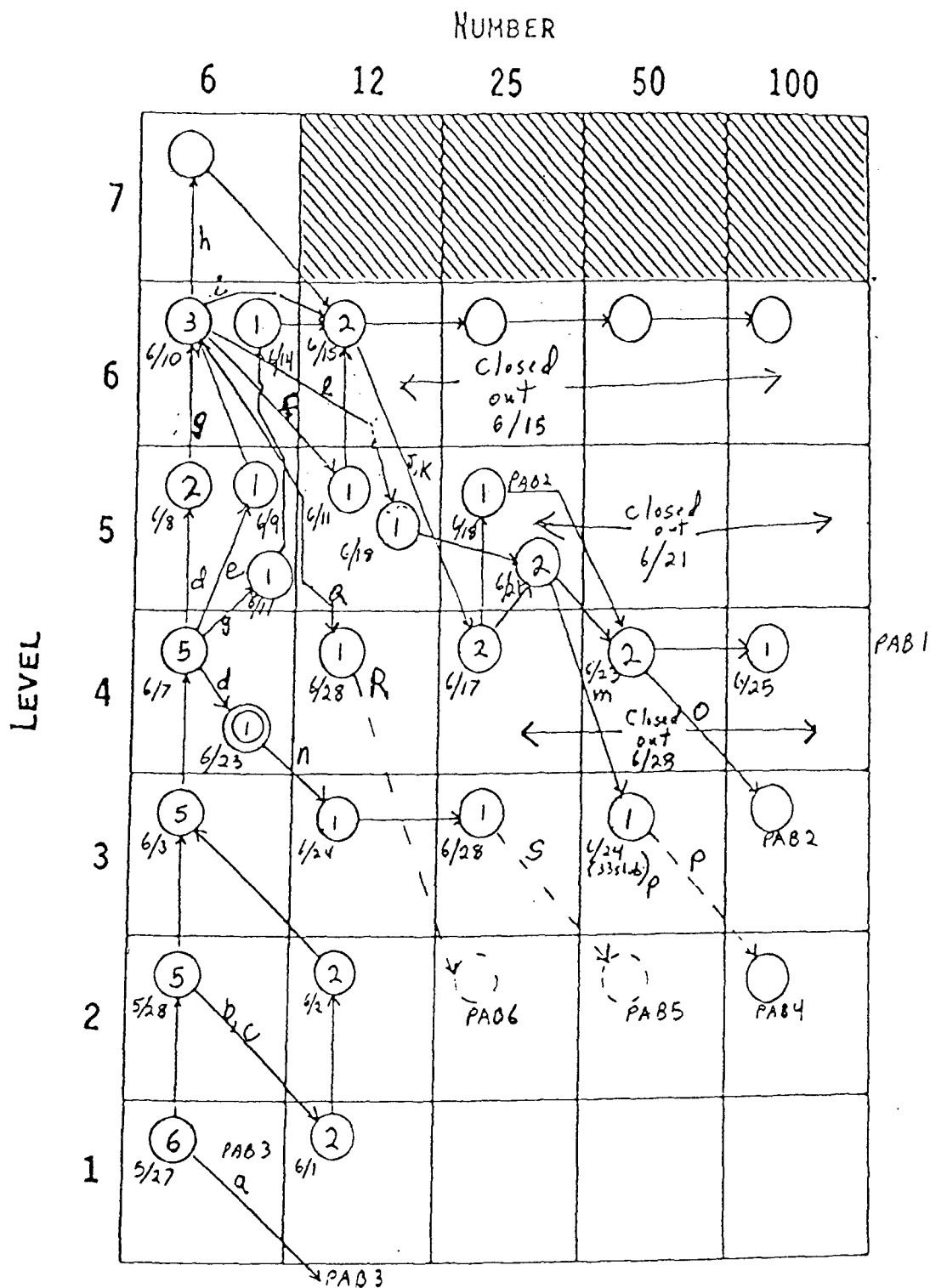


Figure E-57. Group PAB, May-June 1993, 3-M Distance, Perforated Ear Plugs.

Figure E-57.

Group PAB, May-June 1993, 3-M Distance, Perforated Ear Plugs (Continued)

- a. PAB-3 was a conditional auditory failure after 1/6. He was then started on second-level hearing protection. The failure was a TTS of 20 dB at 4 kHz.
- b. PAB-4 was a conditional auditory failure after 2/6. The failure was 17 dB of TTS at 4 kHz.
- c. PAB-6 was a conditional auditory failure after 2/6. The failure was a TTS of 17 dB at 500 Hz.
- d. PAA-5 had a hematoma on his right tympanic membrane after condition 4/6. Further exposure was delayed until recovery. This recovery occurred 17 June 1993 (see note "n" below).
- e. PB1 could not meet his baseline attenuation curves for the perforated plug. He showed 5-8 dB less than normal attenuation in spite of two complete refits and numerous retests. His unoccluded tests were normal. He was exposed the following day and rejoined his group for level 6/6.
- f. PAB-2 was a conditional auditory failure after 6/6 with a 17 dB TTS at 8 kHz.
- g. PAB-4 was dropped, then reinstated, after condition 4/6 because of disciplinary problems.
- h. PAB-1, PAB-4, and PAB-6 elected not to go to level 7.
- i. PAB-1 and PAB-6 were sick prior to condition 6/12 and were not exposed on 6/15/93.
- j. PAB-2 was an auditory failure after 6/12 with a TTS of 33 dB at 4 kHz.
- k. PAB-4 was an auditory failure with a TTS of 50 dB at 4 kHz.
- l. PAB-1 was sick on 15 and 16 June. The PI decided to expose him at 5/12 instead of 6/12 on 18 June.
- m. PAB-4 was an auditory failure with a TTS of 32 dB at 4 kHz after condition 5/25.
- n. PAB-5 was exposed to 1 shot at level 4. No problem occurred. He was then exposed to condition 3/12.
- o. PAB-2 was a conditional auditory failure after condition 4/50 with a TTS of 18 dB at 3 kHz. Because of some ringing, he elected to stop at this point.
- p. PAB-4 stopped after 33 shots because of ringing that subjectively matched the ringing when he had 30 dB TTS. He was a conditional auditory failure after 3/33 with a TTS of 20 dB at 4 kHz. He elected to stop further exposures at this point.
- q. PAB-6 was sick on 15 June and told by Kirtland AFB physicians that he could not be exposed for a week. When he recovered, condition 6/12 was closed and he elected to go to 4/12.
- r. PAB-6 was an auditory failure with a TTS of 17 dB at 2 kHz at 2 min. This TTS grew to reach a maximum of 31 dB at 7 hr at which time recovery started. This subject was dropped from further exposures.
- s. PAB-5 was a conditional auditory failure with a TTS of 17 dB at 2 kHz at 20 min. after condition 3/25. He elected to stop further exposure at that time.

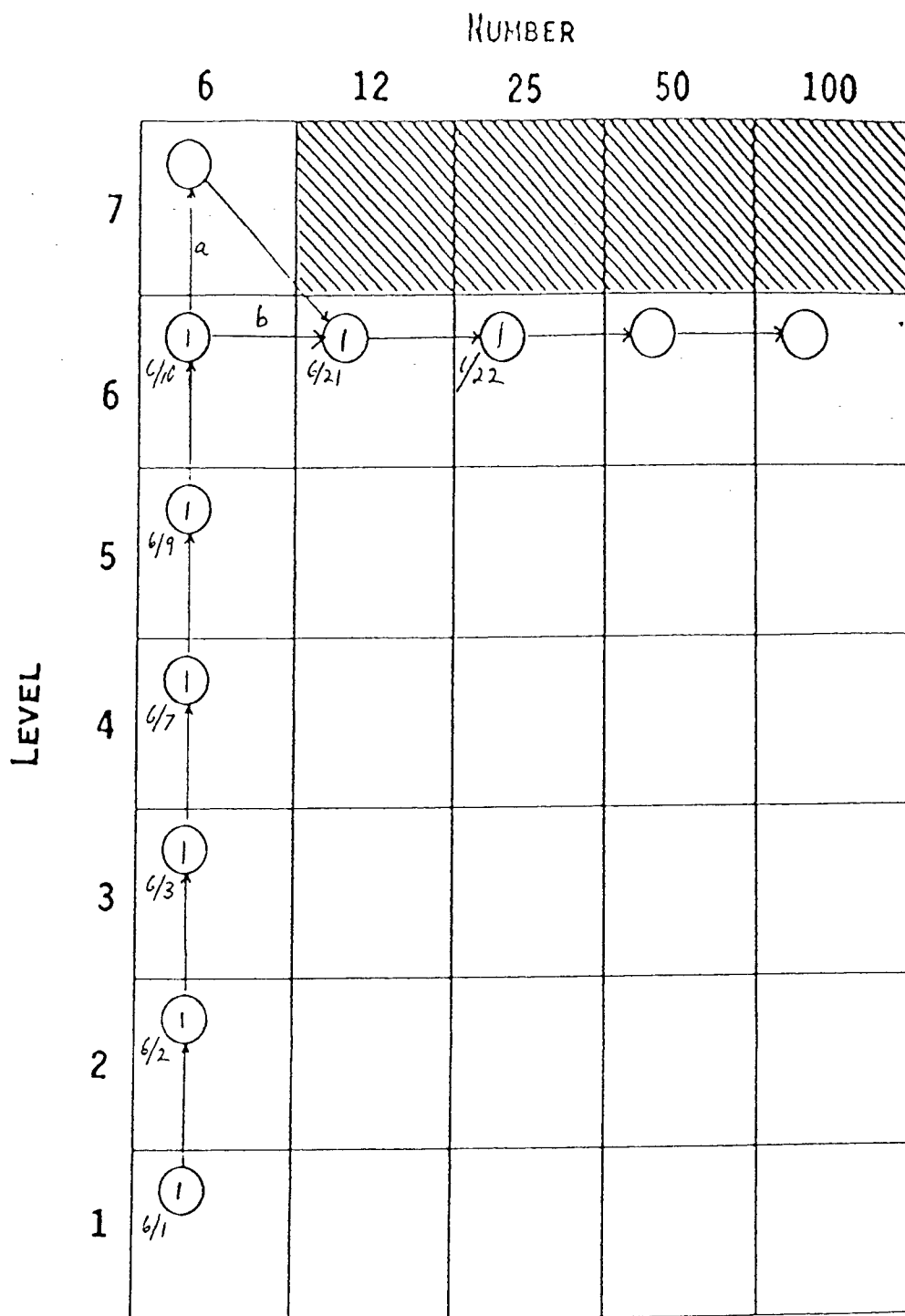


Figure E-58. Subject PAB-3, Second-Level Hearing Protection, May-June 1993, 3-M Distance, Perforated Ear Plugs.

a. PAB-3 elected not to be exposed to level 7.

b. PAB-3 was sick for over a week.

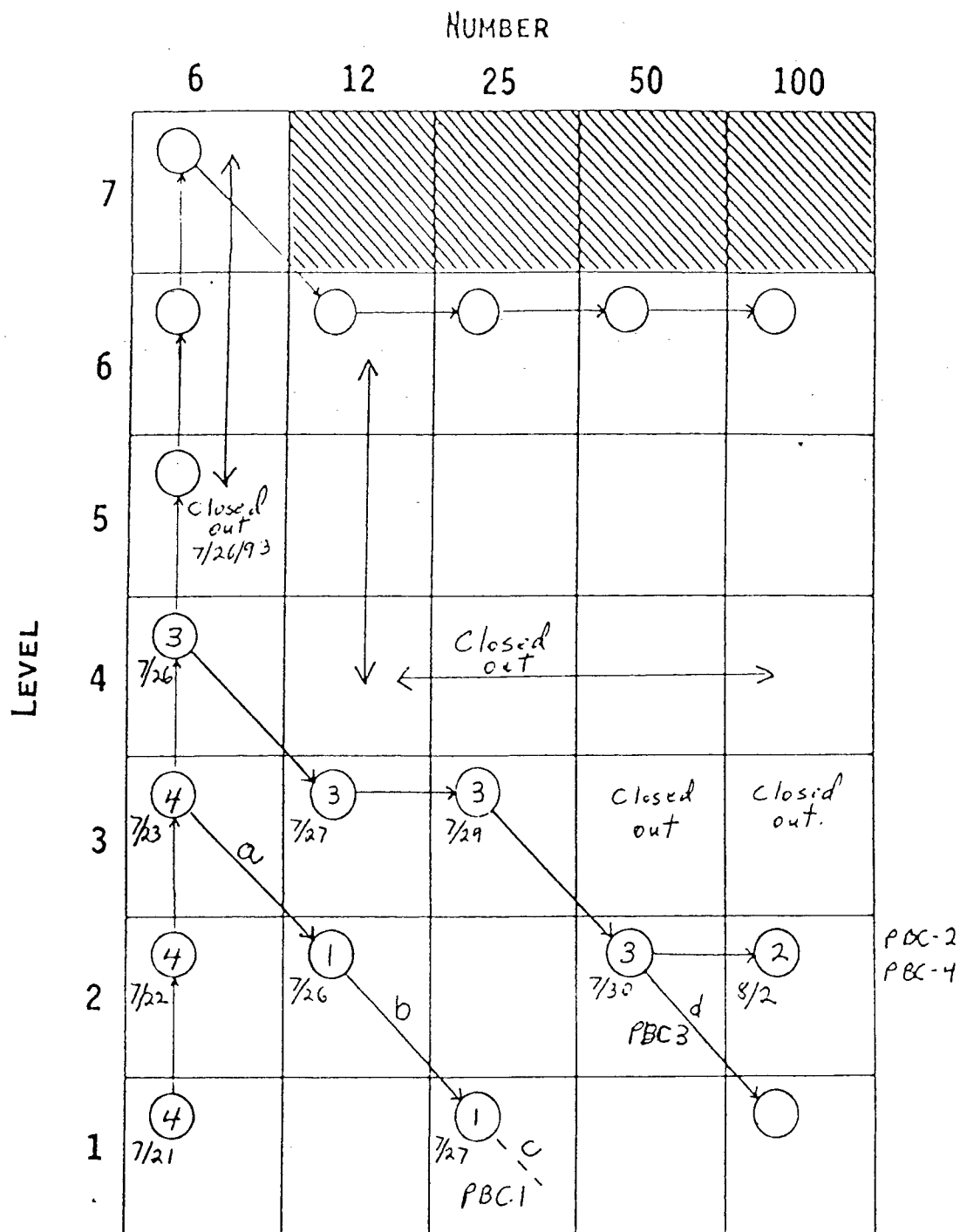


Figure E-59. Group PBC, First-Level Hearing Protection, July-August 1993, 3-M Distance, Perforated Ear Plugs.

- PBC-1 was a conditional auditory failure after 3/6. He had a TTS of 20 dB at 8 kHz.
- PBC-1 was a conditional auditory failure after 2/12. He had a TTS of 20 dB at 8 kHz.
- PBC-1 was an auditory failure after 1/25. He had a TTS of 27 dB at 8 kHz. His exposures with first-level hearing protection were stopped.
- PBC-3 was a conditional auditory failure after 2/50 with a TTS of 21 dB at 500 Hz. He then elected not to be exposed to condition 1/100.

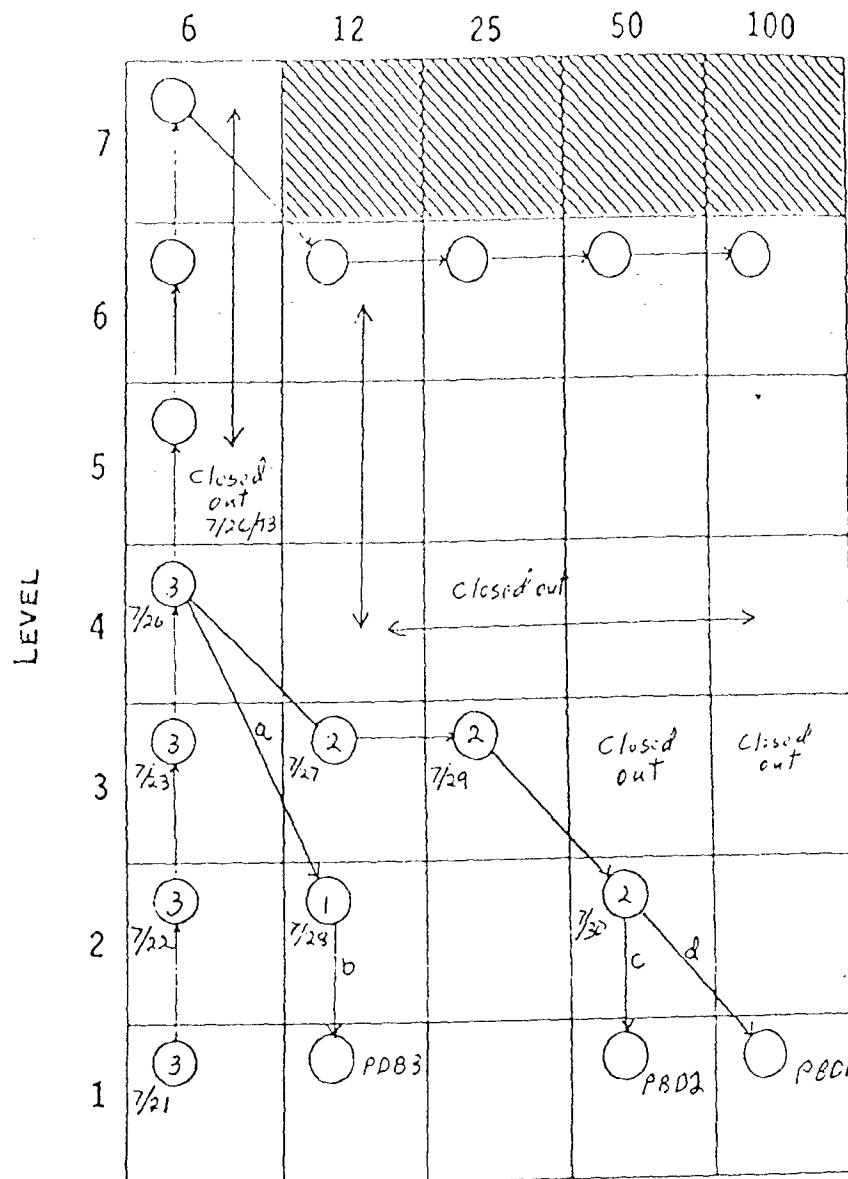


Figure E-60. Group PBD, First-Level Hearing Protection, July-August 1993, 3-M Distance, Perforated Ear Plugs.

- PBD-3 was an auditory failure after condition 4/6. He had a TTS of 28 dB at 2 kHz at 2 min. and a TTS of 21 dB at 3 kHz at 20 min.
- PBD-3 was an auditory failure after condition 2/12 with a TTS of 31 dB at 2 kHz. he also had a TTS of 17 dB at 3 kHz. This TTS did not recover within 24 hr. The subject was dropped from further exposure.
- PBD-2 was an auditory failure after condition 2/50. He had a TTS of 25 dB at 4 kHz. He elected not to be exposed to condition 1/50.
- PBD-1 was an elective failure for condition 2/100. He was willing, however, to be exposed to condition 1/100. He then changed his mind on 3 August and became an elective failure for 1/100 also.

